ControlLogix Analog I/O Modules

Allen-Bradley

Catalog Numbers 1756-IF16, 1756-IF6CIS, 1756-IF6I, 1756-IF8, 1756-IR6I, 1756-IT6I, 1756-IT6I2, 1756-OF4, 1756-OF6CI, 1756-OF6VI, 1756-OF8

User Manual

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Important User Information

Solid state equipment has operational characteristics differing from those of electromechanical equipment. Safety Guidelines for the Application, Installation and Maintenance of Solid State Controls (publication SGI-1.1 available from your local Rockwell Automation sales office or online at http://www.rockwellautomation.com/literature/) describes some important differences between solid state equipment and hard-wired electromechanical devices. Because of this difference, and also because of the wide variety of uses for solid state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

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Throughout this manual, when necessary, we use notes to make you aware of safety considerations.

WARNING	Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.
IMPORTANT	Identifies information that is critical for successful application and understanding of the product.
ATTENTION	Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence.
SHOCK HAZARD	Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present.
BURN HAZARD	Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures.

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Introduction

Changes throughout this manual revision are marked by change bars, as shown to the right of this paragraph.

New and Updated Information

The table explains the new and updated information in this manual.

Section	Changes
Chapter 3	Using electronic keying with examples of Exact Match, Compatible, and Disabled Keying.
Chapter 4 and Chapter 6	Caution for disabling all alarms because it affects the underrange/overrange detection feature.
Appendix A	Updated I/O specifications.
Appendix D	Updated power-sizing chart and link to an interactive spreadsheet to calculate total power consumption for modules in a chassis configuration.
Appendix F	Updated information on interface modules (IFMs) and pre-wired cables that are available with analog I/O modules.

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Introduction

This manual describes how to install, configure, and troubleshoot your ControlLogix analog I/O module.

Who Should Use This Manual

You must be able to program and operate a Rockwell Automation ControlLogix controller to efficiently use your analog I/O modules. If you need additional information, refer to the related documentation listed below.

Additional Resources

The following table lists related ControlLogix products and documentation.

Related Documentation

Cat. No.	Resource
1756-A4, 1756-A7, 1756-A10, 1756-A13, 1756-A17	ControlLogix Chassis, Series B Installation Instructions, publication 1756-IN080
1756-PA72, 1756-PB72, 1756-PA75, 1756-PB75, 1756-PH75, 1756-PC75	ControlLogix Power Supplies Installation Instructions, publication 1756-IN613
1756 digital I/O modules	ControlLogix Digital I/O Modules User Manual, publication 1756-UM058
1756-CNB, 1756-CNBR	ControlNet Modules in Logix5000 Control Systems, publication CNET-UM001
1756-DNB	DeviceNet Modules in Logix5000 Control Systems User Manual, publication DNET-UM004
1756-DHRIO	ControlLogix Data Highway Plus-Remote I/O Communication Interface Module User Manual, publication 1756-UM514
1756-ENBT, 1769-ENET	EtherNet/IP Modules in Logix5000 Control Systems User Manual, publication ENET-UM001
1756-L*x*	ControlLogix Selection Guide, publication 1756-SG001
1756-L*x*	ControlLogix System User Manual, publication 1756-UM001
1756-L*x*, 1769-L*x*, 1789-L*x*, PowerFlex 700S	Logix5000 Controllers Common Procedures Programming Manual, publication 1756-PM001
1756-L*x*, 1769-L*x*, 1789-L*x*, 1794-L*x*, PowerFlex 700S	Logix5000 Controllers General Instructions Reference Manual, publication 1756-RM003

If you need more information on these products, contact your local Rockwell Automation distributor or sales office. The documentation listed in the Related Documentation table is available at http://www..rockwellautomation.com/literature.

Notes:

What Are ControlLogix Analog I/O Modules?

Introduction

This chapter provides an overview of the ControlLogix analog I/O modules to explain to you how they operate.

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ControlLogix analog I/O modules are interface modules that convert analog signals to digital values for inputs and convert digital values to analog signals for outputs. Controllers can then use these signals for control purposes.

By using the producer/consumer network model, ControlLogix analog I/O modules produce information when needed while providing additional system functions.

The table lists several features available on ControlLogix analog I/O modules.

ControlLogix Analog I/O Module Features

Feature	Description
Removal and insertion under power (RIUP)	You can remove and insert modules and removable terminal blocks (RTB) while power is applied.
Producer/consumer communication	This communication is an intelligent data exchange between modules and other system devices in which each module produces data without first being polled.
Rolling timestamp of data	A 15-bit module-specific rolling timestamp with millisecond resolution that indicates when data was sampled and/or applied. This timestamp may be used to calculate the interval between channel or field-side updates.
Multiple data formats	Analog I/O modules offer the option of IEEE 32-bit floating point or 16-bit integer data formats.
Module resolution	Analog input modules use 16-bit resolution, and analog output modules offer 13…16-bit output resolution (depending on the module type), to detect data changes.
On-board features	Scaling to engineering units, alarming, and under/overrange detection, are some examples of the I/O module features.

ControlLogix Analog I/O Module Features

Feature	Description
Calibration	ControlLogix analog I/O module ships from the factory with factory calibration. You can recalibrate the module calibration on a channel-by-channel or module-wide basis to increase accuracy in customer-specific applications, if necessary.
Coordinated system time (CST) time stamp of data	A 64-bit system clock places a time stamp on the transfer of data between the module and its owner-controller within the local chassis.
Agency Certification	Full agency certification for in any application that requires approval. Agency certification varies depending on the catalog number. To see a list of the certifications associated with each catalog number, see Appendix A.

I/O Module in the ControlLogix System

ControlLogix modules mount in a ControlLogix chassis and use a removable terminal block (RTB) or a Bulletin 1492 interface module[1] cable to connect to all field-side wiring.

Before you install and use your module, you should do the following:

- Install and ground a 1756 chassis and power supply[2]. To install these products, refer to the publications listed in Additional Resources on page 13.
- Order and receive an RTB or IFM and its components for your application.

IMPORTANT RTBs and IFMs are not included with your module purchase.

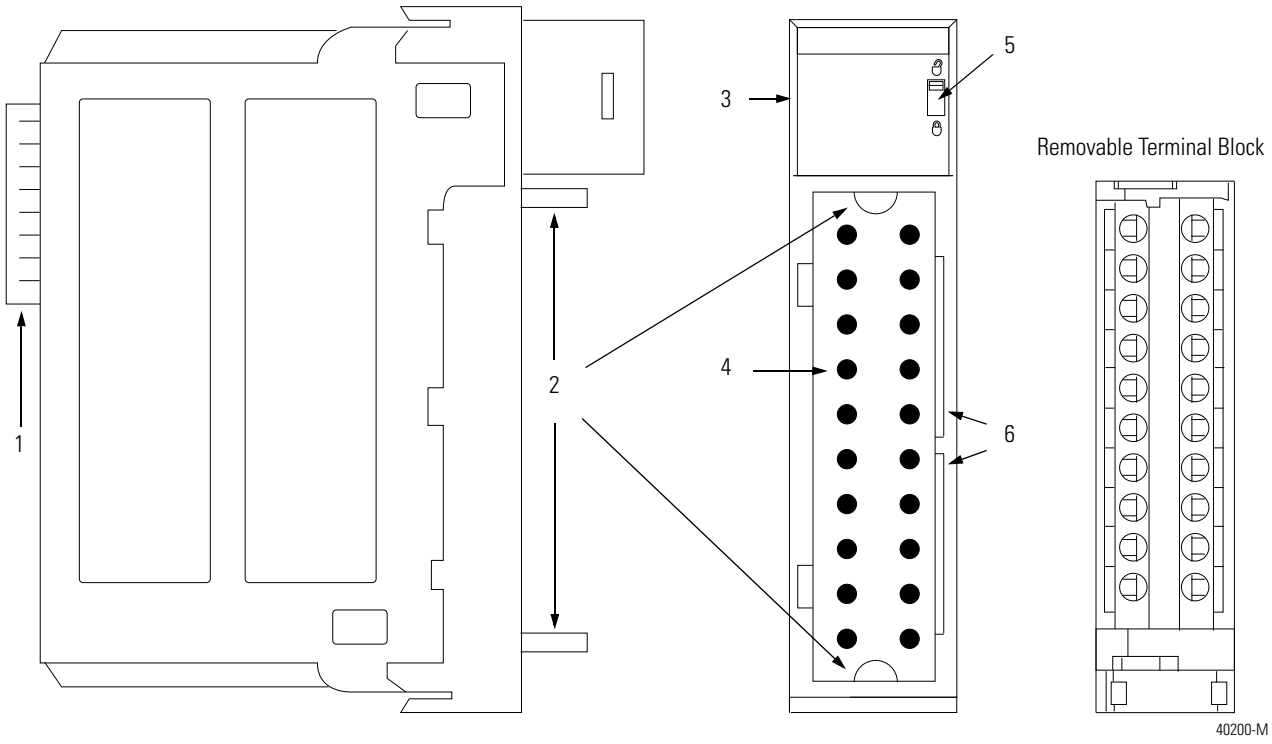
Types of ControlLogix Analog I/O Modules

Cat. No.	Description	RTB Used	Page
1756-IF16	16-point non-isolated analog current/voltage input module	36-pin	294
1756-IF8	8-point non-isolated analog current/voltage input module		289
1756-IF6CIS	6-point sourcing current loop input module	20-pin	279
1756-IF6I	6-point isolated analog current/voltage input module		284
1756-IR6I	6-point isolated RTD input module		299
1756-IT6I	6-point isolated Thermocouple/mV input module		304
1756-IT6I2	6-point isolated Enhanced Thermocouple/mV input module		308
1756-OF4	4-point non-isolated analog current/voltage output module		312
1756-OF8	8-point non-isolated analog current/voltage output module		323
1756-OF6CI	6-point isolated analog current output module		316
1756-OF6VI	6-point isolated analog voltage output module		320

(1) The ControlLogix system has been agency certified using only the ControlLogix RTBs (1756-TBCH, 1756-TBNH, 1756-TBSH and 1756-TBS6H). Any application that requires agency certification of the ControlLogix system using other wiring termination methods may require application specific approval by the certifying agency. To see what analog interface modules are used with each ControlLogix analog I/O module, see Appendix F.

(2) In addition to standard ControlLogix power supplies, ControlLogix Redundant Power Supplies are also available for your application. For more information on these supplies, see the ControlLogix Selection Guide, publication 1756-SG001, or contact your local Rockwell Automation distributor or sales representative.

Parts Illustration of the ControlLogix Analog I/O Module



Item	Description
1	**Backplane connector** - Interface for the ControlLogix system that connects the module to the backplane.
2	**Top and bottom guides** - Guides provide assistance in seating the RTB or IFM cable onto the module.
3	**Status indicators** - Indicators display the status of communication, module health, and input/output devices. Indicators help in troubleshooting anomalies.
4	**Connectors pins** - Input/output, power, and grounding connections are made to the module through these pins with the use of an RTB or IFM.
5	**Locking tab** - The locking tab anchors the RTB or IFM cable on the module, maintaining wiring connections.
6	**Slots for keying** - Mechanically keys the RTB to prevent inadvertently making the wrong wire connections to your module.

Module Identification and Status Information

Each ControlLogix I/O module maintains specific identification information that separates it from all other modules. This information assists you in tracking all the components of your system.

For example, you can track module identification information to be aware of exactly what modules are located in any ControlLogix rack at any time. While retrieving module identity, you can also retrieve the module's status.

Module Identification and Status Information

Item	Description
Product Type	Module's product type, such as Analog I/O or Digital I/O module
Catalog Code	Module's catalog number
Major Revision	Module's major revision number
Minor Revision	Module's minor revision number
Status	Module's status that shows the following information: • Controller ownership (if any) • Whether module has been configured • Device Specific Status, such as: • Self-Test • Flash update in progress • Communications fault • Not owned (outputs in program mode) • Internal fault (need flash update) • Run mode • Program mode (output mods only) • Minor recoverable fault • Minor unrecoverable fault • Major recoverable fault • Major unrecoverable fault
Vendor ID	Module manufacturer vendor, for example Allen-Bradley
Serial Number	Module serial number
Length of ASCII Text String	Number of characters in module's text string
ASCII Text String	Number of characters in module's text string

IMPORTANT You must perform a WHO service to retrieve this information.

Preventing Electrostatic Discharge

This module is sensitive to electrostatic discharge.

ATTENTION

This equipment is sensitive to electrostatic discharge, which can cause internal damage and affect normal operation. Follow these guidelines when you handle this equipment:

- Touch a grounded object to discharge potential static.
- Wear an approved grounding wriststrap.
- Do not touch connectors or pins on component boards.
- Do not touch circuit components inside the equipment.
- If available, use a static-safe workstation.
- When not in use, store the equipment in appropriate static-safe packaging.

Analog I/O Operation in the ControlLogix System

Introduction

I/O modules are interfaces between the controller and the field devices that comprise the ControlLogix system. Analog signals, which are continuous, are converted by the module and used by the controller to mandate field-device results.

This chapter describes how analog I/O modules operate within the ControlLogix system.

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Ownership

Every I/O module in the ControlLogix system must be owned by a ControlLogix controller. This owner-controller:

- stores configuration data for every module that it owns.
- can be local or remote in regard to the I/O module's position.
- sends the I/O module configuration data to define the module's behavior and begin operation within the control system.

Each ControlLogix I/O module must continuously maintain communication with its owner to operate normally.

Typically, each module in the system will have one owner only. Input modules can have more than one owner. Output modules, however, are limited to a single owner.

For more information on the increased flexibility provided by multiple owners and the ramifications of using multiple owners, see Configuration Changes in an Input Module with Multiple Owners on page 34.

Using RSNetWorx and RSLogix 5000 Software

The I/O configuration portion of the RSLogix5000 programming software generates the configuration data for each I/O module in the control system, whether the module is in a local or remote chassis. A remote chassis, also known as networked, contains the I/O module but not the module's owner-controller. A remote chassis can be connected to the controller via a scheduled connection on the ControlNet network or an EtherNet/IP network.

RSLogix 5000 configuration data is transferred to the controller during the program download and subsequently transferred to the appropriate I/O modules. I/O modules in the local chassis, and modules in a remote chassis connected via the EtherNet/IP network, or unscheduled connections on the ControlNet network, are ready to run as soon as the configuration data has been downloaded. However, to enable scheduled connections to I/O modules on the ControlNet network, you must schedule the network by using RSNetWorx for ControlNet software.

Running RSNetWorx software transfers configuration data to I/O modules on a scheduled ControlNet network and establishes a network update time (NUT) for the ControlNet network that is compliant with the desired communication options specified for each module during configuration.

Anytime a controller references a scheduled connection to I/O modules on a scheduled ControlNet network, you must run RSNetWorx software to configure the ControlNet network.

Refer to the following general steps when configuring I/O modules.

1. Configure all I/O modules for a given controller by using RSLogix 5000 programming software and download that information to the controller.

2. If the I/O configuration data references a scheduled connection to a module in a remote chassis connected via the ControlNet network, run RSNetWorx for ControlNet software to schedule the network.

3. After running RSNetWorx software, perform an online save of the RSLogix 5000 project so the configuration information that RSNetWorx software sends to the controller is saved..

IMPORTANT You must run RSNetWorx for ControlNet software whenever a new I/O module is added to a scheduled ControlNet chassis. When a module is permanently removed from a remote chassis, we recommend that you run RSNetWorx for ControlNet software to reschedule the network and optimize the allocation of network bandwidth.

Direct Connections

ControlLogix analog I/O modules use direct connections only.

A direct connection is a real-time data transfer link between the controller and the device that occupies the slot that the configuration data references. When module configuration data is downloaded to an owner-controller, the controller attempts to establish a direct connection to each of the modules referenced by the data.

If a controller has configuration data referencing a slot in the control system, the controller periodically checks for the presence of a device there. When a device's presence is detected there, the controller automatically sends the configuration data, and one of the following events occurs:

- If the data is appropriate to the module found in the slot, a connection is made and operation begins.
- If the configuration data is not appropriate, the data is rejected and an error message displays in the software. In this case, the configuration data can be inappropriate for any of a number of reasons.

  For example, a module's configuration data may be appropriate except for a mismatch in electronic keying that prevents normal operation.

The controller maintains and monitors its connection with a module. Any break in the connection, such as removal of the module from the chassis while under power, causes the controller to set fault status bits in the data area associated with the module. The RSLogix 5000 programming software monitors this data area to annunciate the module's failures.

Input Module Operation

In traditional I/O systems, controllers poll input modules to obtain their input status. In the ControlLogix system, a controller does not poll analog input modules after a connection is established. Instead, the modules multicast their data periodically. The frequency depends on the options chosen during configuration and where in the control system that input module physically resides.

An input module's behavior varies depending upon whether it operates in the local chassis or in a remote chassis. The following sections detail the differences in data transfers between these set-ups.

Input Modules in a Local Chassis

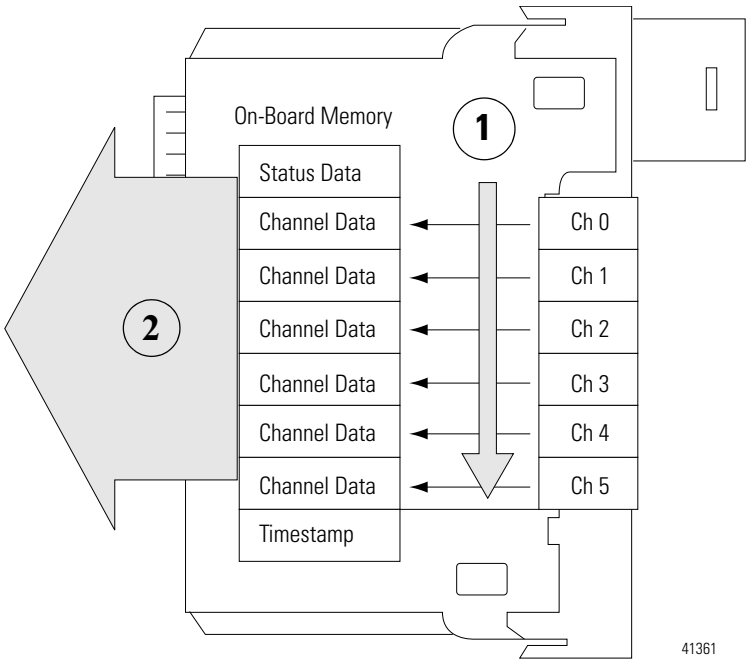
When a module resides in the same chassis as the owner-controller, the following two configuration parameters will affect how and when an input module produces data:

- Real Time Sample (RTS)
- Requested Packet Interval (RPI)

Real Time Sample (RTS)

This configurable parameter, which is set during the initial configuration by using RSLogix5000 software, instructs the module to perform two basic operations:

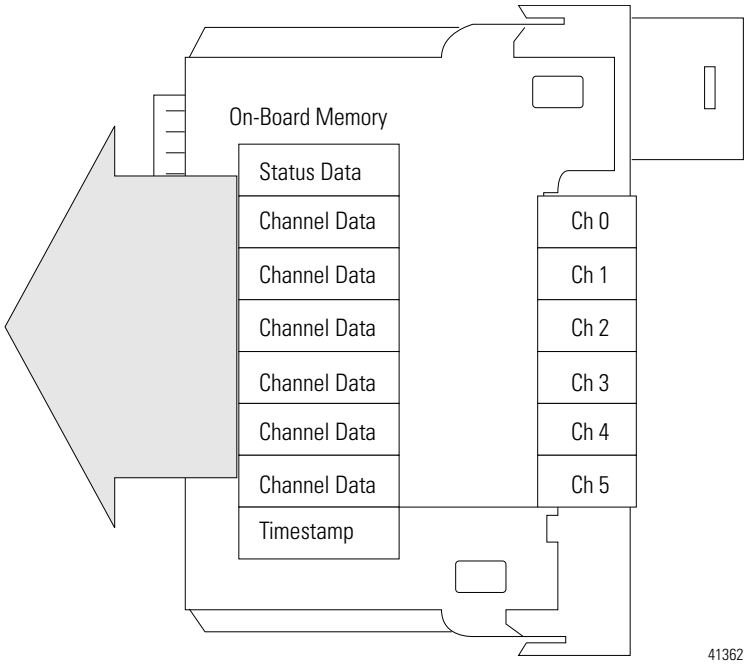
1. Scan all of its input channels and store the data into on-board memory.
2. Multicast the updated channel data (as well as other status data) to the backplane of the local chassis.



Requested Packet Interval (RPI)

This configurable parameter also instructs the module to multicast its channel and status data to the local chassis backplane.

The RPI, however, instructs the module to produce the current contents of its on-board memory when the RPI expires, (that is, the module does not update its channels prior to the multicast).



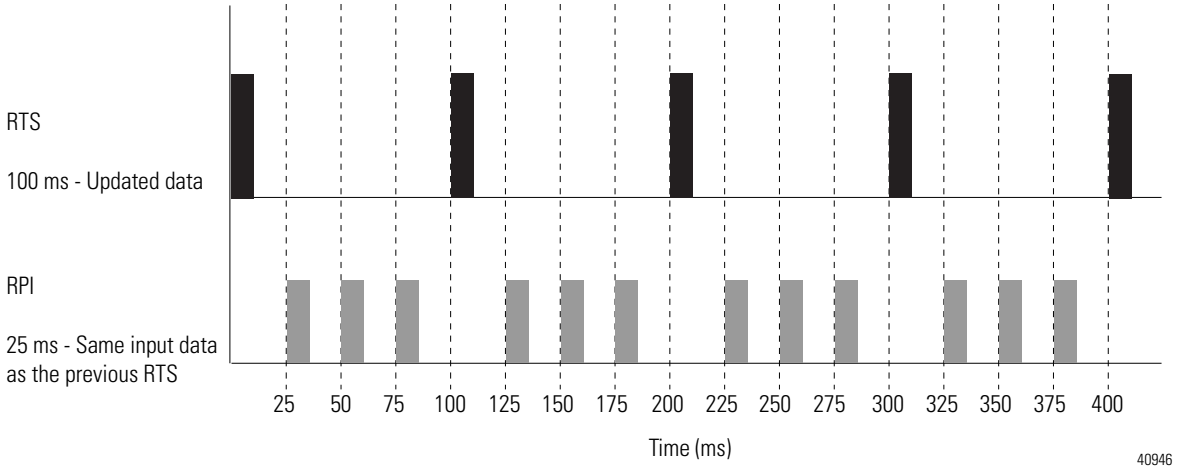
IMPORTANT The RPI value is set during the initial module configuration by using RSLogix 5000 software. This value can be adjusted when the controller is in Program mode.

The module will reset the RPI timer each time an RTS is performed. This operation dictates how and when the owner-controller in the local chassis will receive updated channel data, depending on the values given to these parameters.

If the RTS value is less than or equal to the RPI, each multicast of data from the module will have updated channel information. In effect, the module is only multicasting at the RTS rate.

If the RTS value is greater than the RPI, the module produces at both the RTS rate and the RPI rate. Their respective values will dictate how often the owner-controller will receive data and how many multicasts from the module contain updated channel data.

In the example below, the RTS value is 100 ms and the RPI value is 25 ms. Only every fourth multicast from the module will contain updated channel data.


RTS
100 ms - Updated data
RPI
25 ms - Same input data as the previous RTS
25 50 75 100 125 150 175 200 225 250 275 300 325 350 375 400
Time (ms)
40946

Triggering Event Tasks

When configured, ControlLogix analog input modules can trigger an event task. The event task lets you execute a section of logic immediately when an event (that is, receipt of new data) occurs.

Your ControlLogix analog I/O module can trigger event tasks every RTS, after the module has sampled and multicast its data. Events tasks are useful for synchronizing process variable (PV) samples and proportional integral derivative (PID) calculations.

IMPORTANT ControlLogix analog I/O modules can trigger event tasks at every RTS but not at the RPI. For example, in the illustration above, an event task can be only triggered every 100 ms.

Input Modules in a Remote Chassis

If an input module physically resides in a remote chassis, the role of the RPI and the module's RTS behavior change slightly with respect to getting data to the owner-controller, depending on what network type you are using to connect to the modules.

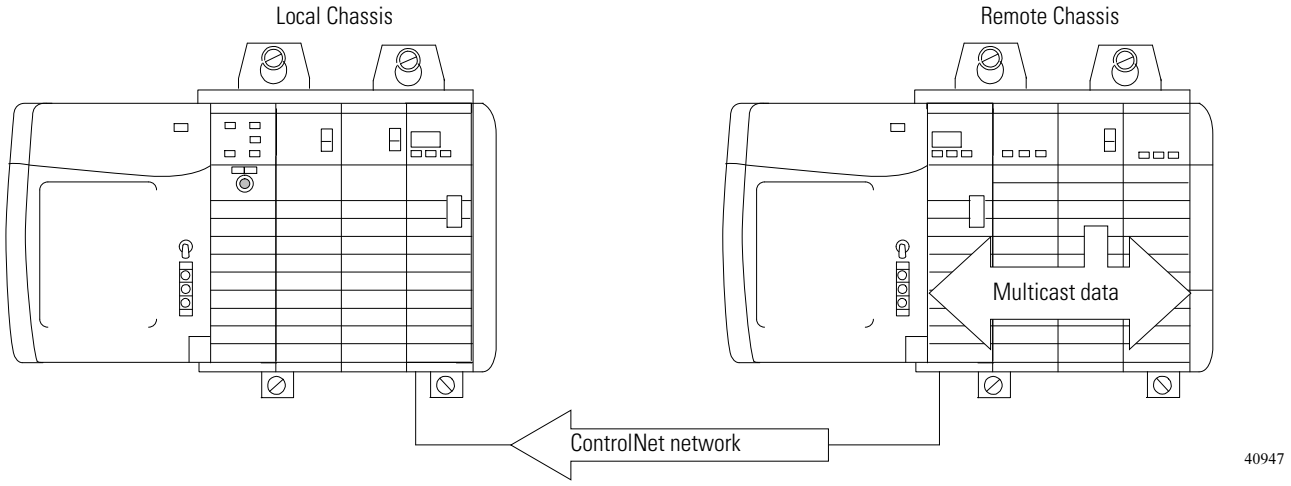
Remote Input Modules Connected Via the ControlNet Network

When remote analog I/O modules are connected to the owner-controller via a scheduled ControlNet network, the RPI and RTS intervals still define when the module will multicast data within its own chassis (as described in the previous section). However, only the value of the RPI determines how often the owner-controller will receive it over the network.

When an RPI value is specified for an input module in a remote chassis connected by a scheduled ControlNet network, in addition to instructing the module to multicast data within its own chassis, the RPI also 'reserves' a spot in the stream of data flowing across the ControlNet network.

The timing of this 'reserved' spot may or may not coincide with the exact value of the RPI, but the control system guarantees that the owner-controller receives data at least as often as the specified RPI.

As shown in the illustration below, the input data within the remote chassis is multicast at the configured RPI. The ControlNet bridge module sends input data back to the owner-controller at least as often as the RPI.



The 'reserved' spot on the network and the module's RTS are asynchronous to each other. This means there are best and worst Case scenarios as to when the owner-controller will receive updated channel data from the module in a networked chassis.

Best Case RTS Scenario

In the best case scenario, the module performs an RTS multicast with updated channel data just before the 'reserved' network slot is made available. In this case, the remotely-located owner-controller receives the data almost immediately.

Worst Case RTS Scenario

In the worst case scenario, the module performs an RTS multicast just after the 'reserved' network slot has passed. In this case, the owner-controller will not receive data until the next scheduled network slot.

TIP Because it is the RPI and not the RTS that dictates when the module's data will be sent over the network, we recommend the RPI value be set less than or equal to the RTS to make sure that updated channel data is received by the owner-controller with each receipt of data.

Remote Input Modules Connected Via the EtherNet/IP Network

When remote analog input modules are connected to the owner-controller via an EtherNet/IP network, data is transferred to the owner-controller in the following way:

- At the RTS or RPI (whichever is faster), the module broadcasts data within its own chassis.
- The 1756 Ethernet bridge module in the remote chassis immediately sends the module's data over the network to the owner-controller as long as it has not sent data within a time frame that is one-quarter the value of the analog input module's RPI.

  For example, if an analog input module uses an RPI = 100 ms, the Ethernet module sends module data immediately on receiving it if another data packet was not sent within the last 25 ms.

  The Ethernet module will either multicast the module's data to all devices on the network or unicast to a specific owner-controller depending on the setting of the Unicast box, as shown on page 209.

TIP For more information, see the Guidelines to Specify an RPI Rate for I/O Modules section in the Logix5000 Controllers Design Considerations Reference Manual, publication 1756-RM094.

Output Module Operation

The RPI parameter governs exactly when an analog output module receives data from the owner-controller and when the output module echoes data. An owner-controller sends data to an analog output module only at the period specified in the RPI. Data is **not** sent to the module at the end of the controller's program scan.

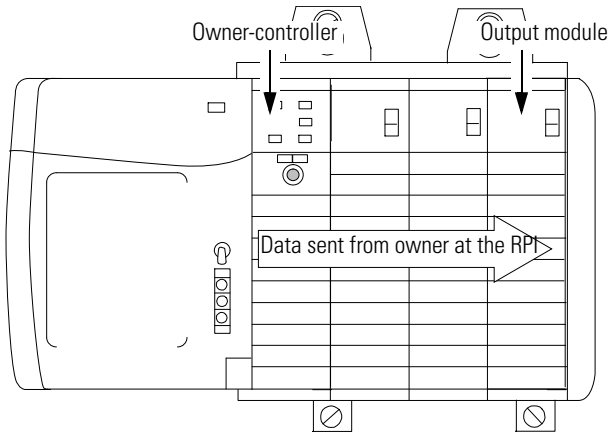
When an analog output module receives new data from an owner-controller (that is, every RPI), the module automatically multicasts or 'echoes' a data value that corresponds to the analog signal present at the output terminals to the rest of the control system. This feature, called Output Data Echo, occurs whether the output module is local or remote.

Depending on the value of the RPI, with respect to the length of the controller program scan, the output module can receive and 'echo' data multiple times during one program scan.

When the RPI is less than the program scan length, the controller effectively allows the module's output channels to change values multiple times during a single program scan because the output module is not dependent on reaching the end of the program to send data.

Output Modules in a Local Chassis

When specifying an RPI value for an analog output module, you instruct the controller when to broadcast the output data to the module. If the module resides in the same chassis as the owner-controller, the module receives the data almost immediately after the controller sends it.



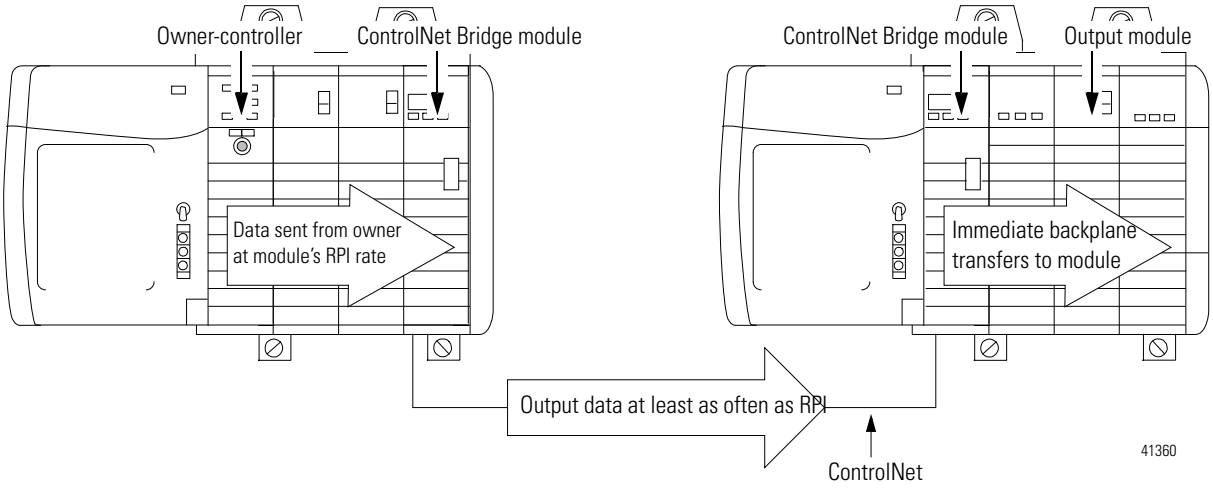
Output Modules in a Remote Chassis

If an output module resides in a remote chassis, the role of the RPI changes slightly with respect to getting data from the owner-controller, depending on what network type you are using to connect to the modules.

Remote Output Modules Connected Via the ControlNet Network

When remote analog output modules are connected to the owner-controller via a scheduled ControlNet network, in addition to instructing the controller to multicast the output data within its own chassis, the RPI also 'reserves' a spot in the stream of data flowing across the ControlNet network.

The timing of this 'reserved' spot may or may not coincide with the exact value of the RPI, but the control system will guarantee that the output module will receive data at least as often as the specified RPI.



The 'reserved' spot on the network and when the controller sends the output data are asynchronous to each other. This means there are best and worst case scenarios as to when the module will receive the output data from the controller in a networked chassis.

Best Case RPI Scenario

In the best case scenario, the controller sends the output data just **before** the 'reserved' network slot is available. In this case, the remotely-located output module receives the data almost immediately.

Worst Case RPI Scenario

In the worst case scenario, the controller sends the data just **after** the 'reserved' network slot has passed. In this case, the module does not receive the data until the next scheduled network slot.

IMPORTANT

These best and worst case scenarios indicate the time required for output data to transfer from the controller to the module once the controller has produced it.

The scenarios do not take into account when the module will receive new data (updated by the user program) from the controller. That is a function of the length of the user program and its asynchronous relationship with the RPI.

Remote Output Modules Connected Via the EtherNet/IP Network

When remote analog output modules are connected to the owner-controller via an EtherNet/IP network, the controller multicasts data in the following ways:

- At the RPI, the owner-controller multicasts data within its own chassis.
- When the RPI timer expires or a programmed Immediate Output (IOT) instruction is executed. An IOT sends data immediately and resets the RPI timer.

Listen-only Mode

Any controller in the system can listen to the data from any I/O module (that is, input data or 'echoed' output data) even if the controller does not own the module. In other words, the controller does not have to own a module's configuration data to listen to it.

During the I/O configuration process, you can specify one of several 'Listen-Only' modes in the Comm Format box on the New Module dialog box. See page 205 for more Comm Format details.

Choosing a 'Listen-Only' mode option allows the controller and module to establish communications without the controller sending any configuration data. In this instance, another controller owns the module being listened to.

IMPORTANT

If a 'Listen-Only' connection is being used by any controller to the module, any connections over the Ethernet network cannot use the Unicast option. See the Unicast box on page 209 for details.

The 'Listen-Only' controller continues to receive multicast data from the I/O module as long as a connection between an owner-controller and I/O module is maintained

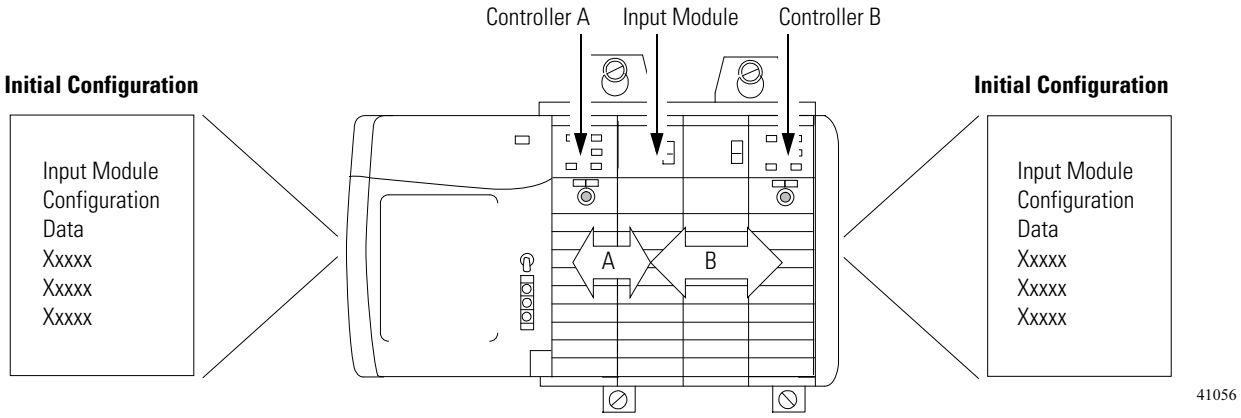
If the connection between all owner-controllers and the module is broken, the module stops multicasting data and connections to all 'Listening controllers' are also broken.

Multiple Owners of Input Modules

Because 'Listening controllers' lose their connections to modules when communication with the owner stops, the ControlLogix system lets you define more than one owner for input modules.

IMPORTANT Only input modules can have multiple owners. If multiple owners are connected to the same input module, they must maintain identical configuration for that module.

In the example below, Controller A and Controller B have both been configured to be the owner of the input module.



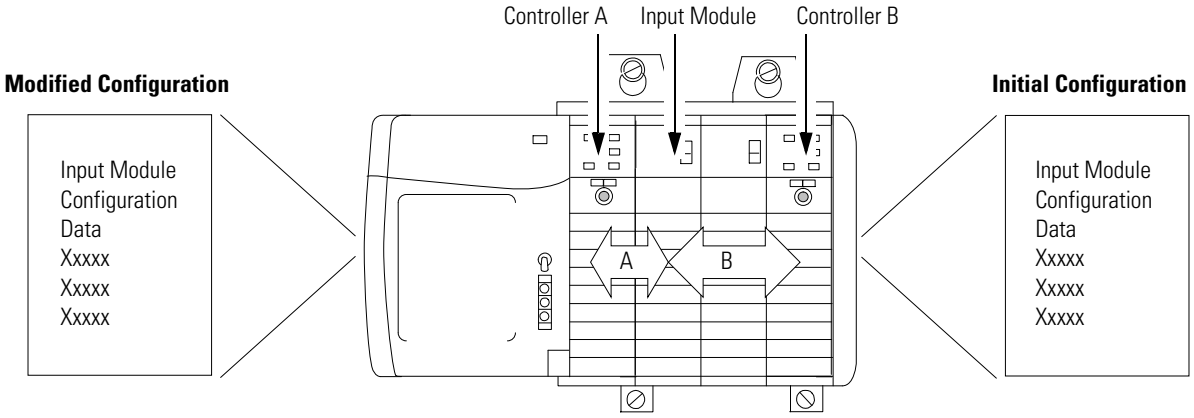
When multiple controllers are configured to own the same input module, the following events occur:

- When the controllers begin downloading configuration data, both try to establish a connection with the input module.
- Whichever controller's data arrives first establishes a connection.
- When the second controller's data arrives, the module compares it to its current configuration data (the data received and accepted from the first controller).
  - If the configuration data sent by the second controller matches the configuration data sent by the first controller the connection is also accepted.
  - If any parameter of the second configuration data is different from the first, the module rejects the connection; RSLogix 5000 software alerts you to the rejected connection through an error message.

The advantage of multiple owners over a 'Listen-only' connection is that now either of the controllers can lose the connection to the module and the module will continue to operate and multicast data to the system because of the connection maintained by the other owner-controller.

Configuration Changes in an Input Module with Multiple Owners

You must be careful when changing an input module's configuration data in a multiple owner scenario. When the configuration data is changed in one of the owners, for example, Controller A, and sent to the module, that configuration data is accepted as the new configuration for the module. Controller B continues to listen, unaware that any changes have been made in the module's behavior.



Controller B is unaware that changes were made by Controller A.

IMPORTANT A pop-up screen in RSLogix 5000 software alerts you to the possibility of a multiple owner situation and lets you inhibit the connection before changing the module's configuration. When changing configuration for a module with multiple owners, we recommend the connection be inhibited.

To prevent other owners from receiving potentially erroneous data, do the following steps when changing a module's configuration in a multiple owner-controller scenario while online.

1. For each owner-controller, inhibit the controller's connection to the module, either in the software on the Connection tab or the pop-up window warning of the multiple owner-controller condition.

2. Make the appropriate configuration data changes in the software. For detailed information on using RSLogix 5000 software to change configuration, see Chapter 10.

3. Repeat step 1 and step 2 for all owner-controllers, making the exact same changes in all controllers.

4. Disable the Inhibit box in each owner's configuration.

ControlLogix Analog I/O Module Features

Introduction

This chapter describes features that are common to all ControlLogix analog I/O modules.

ControlLogix analog input modules convert an analog signal of either volts, millivolts, milliamps, or ohms that is connected to the module's screw terminals into a digital value.

The digital value that represents the magnitude of the analog signal is then transmitted on the backplane to either a controller or other control entities.

ControlLogix output modules convert a digital value that is delivered to the module via the backplane into an analog signal of -10.5…10.5 volts or 0…21 milliamps.

The digital value represents the magnitude of the desired analog signal. The module converts the digital value into an analog signal and provides this signal on the module's screw terminals.

Common Analog I/O Features

The following table lists common features for analog I/O modules.

Feature	Page
Removal and Insertion Under Power (RIUP)	36
Module Fault Reporting	36
Configurable Software	36
Electronic Keying	37
Access to System Clock for Timestamp Functions	44
Rolling Timestamp	44
Producer/Consumer Model	44
Status Indicator Information	45
Full Class I Division 2 Compliance	45
Agency Certification	45
Field Calibration	45
Sensor Offset	46
Latching of Alarms	46

Removal and Insertion Under Power (RIUP)

All ControlLogix I/O modules can be inserted and removed from the chassis while power is applied. This feature allows greater availability of the overall control system because, while the module is being removed or inserted, there is no additional disruption to the rest of the controlled process.

Module Fault Reporting

ControlLogix analog I/O modules provide both hardware and software indication when a module fault has occurred. Each module has a status fault indicator. RSLogix 5000 software graphically displays this fault and includes a fault message that describes the nature of the fault. This feature lets you determine how your module has been affected and what action should be taken to resume normal operation.

For more information on module fault reporting as it relates to specific modules, see the chapter describing that module, either chapter 4, 5, 6, 7 or 8.

Configurable Software

The RSLogix 5000 software uses a custom, easily understood interface to write configuration. All module features are enabled or disabled through the I/O configuration portion of the software.

You can also use the software to interrogate any module in the system to retrieve:

- serial number.
- revision information.
- catalog number.
- vendor identification.
- error/fault information.
- diagnostic counters.

By eliminating such tasks as setting hardware switches and jumpers, the software makes module configuration easier and more reliable.

Electronic Keying

The electronic keying feature automatically compares the expected module, as shown in the RSLogix 5000 I/O Configuration tree, to the physical module before I/O communication begins. You can use electronic keying to help prevent communication to a module that does not match the type and revision expected.

For each module in the I/O Configuration tree, the user-selected keying option determines if, and how, an electronic keying check is performed. Typically, three keying options are available.

- Exact Match
- Compatible Keying
- Disable Keying

You must carefully consider the benefits and implications of each keying option when selecting between them. For some specific module types, fewer options are available.

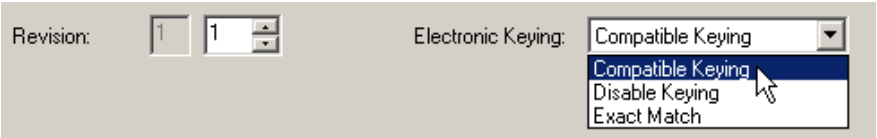
Electronic keying is based on a set of attributes unique to each product revision. When a Logix5000 controller begins communicating with a module, this set of keying attributes is considered.

Keying Attributes

Attribute	Description
Vendor	The manufacturer of the module, for example, Rockwell Automation/Allen-Bradley.
Product Type	The general type of the module, for example, communication adapter, AC drive, or digital I/O.
Product Code	The specific type of module, generally represented by its catalog number, for example, 1756-IB16I.
Major Revision	A number that represents the functional capabilities and data exchange formats of the module. Typically, although not always, a later, that is higher, Major Revision supports at least all of the data formats supported by an earlier, that is lower, Major Revision of the same catalog number and, possibly, additional ones.
Minor Revision	A number that indicates the module's specific firmware revision. Minor Revisions typically do not impact data compatibility but may indicate performance or behavior improvement.

You can find revision information on the General tab of a module's Properties dialog box.

General Tab



IMPORTANT Changing electronic keying selections online may cause the I/O communication connection to the module to be disrupted and may result in a loss of data.

Exact Match

Exact Match Keying requires all keying attributes, that is, Vendor, Product Type, Product Code (catalog number), Major Revision, and Minor Revision, of the physical module and the module created in the software to match precisely to establish communication. If any attribute does not match precisely, I/O communication is not permitted with the module or with modules connected through it, as in the case of a communication module.

Use Exact Match keying when you need the system to verify that the module revisions in use are exactly as specified in the project, such as for use in highly-regulated industries. Exact Match keying is also necessary to enable Automatic Firmware Update for the module via the Firmware Supervisor feature from a Logix5000 controller.

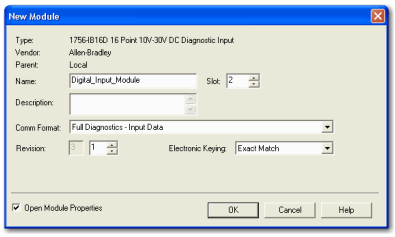
EXAMPLE

In the following scenario, **Exact Match keying prevents I/O communication**:

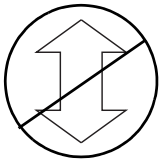
- The module configuration is for a 1756-IB16D module with module revision 3.1. The physical module is a 1756-IB16D module with module revision 3.2. In this case, communication is prevented because the Minor Revision of the module does not match precisely.

Module Configuration

Vendor = Allen-Bradley
Product Type = Digital Input Module
Catalog Number = 1756-IB16D
Major Revision = 3
Minor Revision = 1

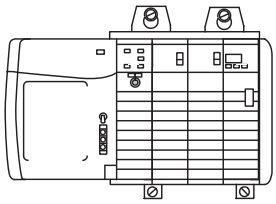


Communication is prevented



Physical Module

Vendor = Allen-Bradley
Product Type = Digital Input Module
Catalog Number = 1756-IB16D
Major Revision = 3
Minor Revision = 2



IMPORTANT

Changing electronic keying selections online may cause the I/O Communication connection to the module to be disrupted and may result in a loss of data.

Compatible Keying

Compatible Keying indicates that the module determines whether to accept or reject communication. Different module families, communication adapters, and module types implement the compatibility check differently based on the family capabilities and on prior knowledge of compatible products.

Compatible keying is the default setting. Compatible keying allows the physical module to accept the key of the module configured in the software, provided that the configured module is one the physical module is capable of emulating. The exact level of emulation required is product and revision specific.

With Compatible keying, you can replace a module of a certain Major Revision with one of the same catalog number and the same or later, that is higher, Major Revision. In some cases, the selection makes it possible to use a replacement that is a different catalog number than the original. For example, you can replace a 1756-CNBR module with a 1756-CN2R module.

Release notes for individual modules indicate the specific compatibility details.

When a module is created, the module developers consider the module's development history to implement capabilities that emulate those of the previous module. However, the developers cannot know future developments. Because of this, when a system is configured, we recommend that you configure your module by using the earliest, that is, lowest, revision of the physical module that you believe will be used in the system. By doing this, you can avoid the case of a physical module rejecting the keying request because it is an earlier revision than the one configured in the software.

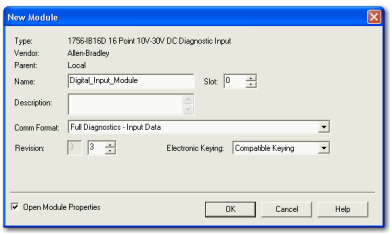
EXAMPLE

In the following scenario, **Compatible keying prevents I/O communication**:

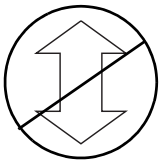
- The module configuration is for a 1756-IB16D module with module revision 3.3. The physical module is a 1756-IB16D module with module revision 3.2. In this case, communication is prevented because the minor revision of the module is lower than expected and may not be compatible with 3.3.

Module Configuration

Vendor = Allen-Bradley
Product Type = Digital Input Module
Catalog Number = 1756-IB16D
Major Revision = 3
Minor Revision = 3

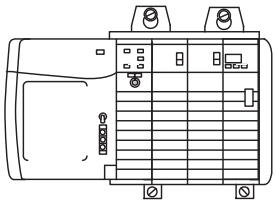


Communication is prevented



Physical Module

Vendor = Allen-Bradley
Product Type = Digital Input Module
Catalog Number = 1756-IB16D
Major Revision = 3
Minor Revision = 2



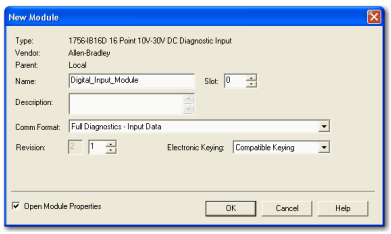
EXAMPLE

In the following scenario, **Compatible keying allows I/O communication**:

- The module configuration is for a 1756-IB16D module with module revision 2.1. The physical module is a 1756-IB16D module with module revision 3.2. In this case, communication is allowed because the major revision of the physical module is higher than expected and the module determines that it is compatible with the prior major revision.

Module Configuration

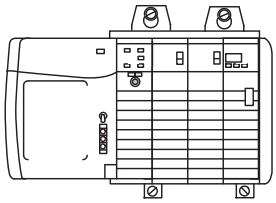
Vendor = Allen-Bradley
Product Type = Digital Input Module
Catalog Number = 1756-IB16D
Major Revision = 2
Minor Revision = 1



Communication is allowed

Physical Module

Vendor = Allen-Bradley
Product Type = Digital Input Module
Catalog Number = 1756-IB16D
Major Revision = 3
Minor Revision = 2



IMPORTANT

Changing electronic keying selections online may cause the I/O communication connection to the module to be disrupted and may result in a loss of data.

Disabled Keying

Disabled Keying indicates the keying attributes are not considered when attempting to communicate with a module. Other attributes, such as data size and format, are considered and must be acceptable before I/O communication is established. With Disabled keying, I/O communication may occur with a module other than the type specified in the I/O Configuration tree with unpredictable results. We generally do not recommend using Disabled keying.

ATTENTION

Be extremely cautious when using Disabled keying; if used incorrectly, this option can lead to personal injury or death, property damage, or economic loss.

If you use Disabled keying, you must take full responsibility for understanding whether the module being used can fulfill the functional requirements of the application.

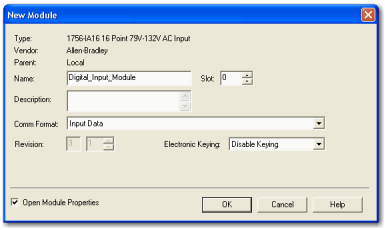
EXAMPLE

In the following scenario, **Disable keying prevents I/O communication**:

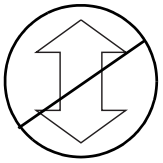
- The module configuration is for a 1756-IA16 digital input module. The physical module is a 1756-IF16 analog input module. In this case, **communication is prevented because the analog module rejects the data formats that the digital module configuration requests**.

Module Configuration

Vendor = Allen-Bradley
Product Type = Digital Input Module
Catalog Number = 1756-IA16
Major Revision = 3
Minor Revision = 1

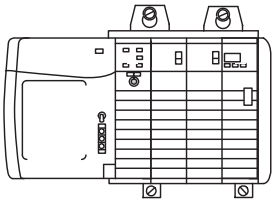


Communication is prevented



Physical Module

Vendor = Allen-Bradley
Product Type = Analog Input Module
Catalog Number = 1756-IF16
Major Revision = 3
Minor Revision = 2



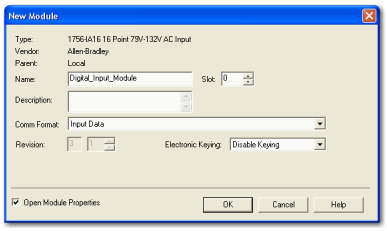
EXAMPLE

In the following scenario, **Disable keying allows I/O communication**:

- The module configuration is for a 1756-IA16 digital input module. The physical module is a 1756-IB16 digital input module. In this case, communication is allowed because the two digital modules share common data formats.

Module Configuration

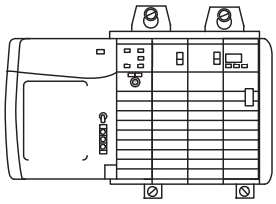
Vendor = Allen-Bradley
Product Type = Digital Input Module
Catalog Number = 1756-IA16
Major Revision = 2
Minor Revision = 1



Communication is allowed

Physical Module

Vendor = Allen-Bradley
Product Type = Digital Input Module
Catalog Number = 1756-IB16
Major Revision = 3
Minor Revision = 2



IMPORTANT

Changing electronic keying selections online may cause the I/O communication connection to the module to be disrupted and may result in a loss of data.

Access to System Clock for Timestamp Functions

Controllers within the ControlLogix chassis maintain a system clock. This clock is also known as the coordinated system time (CST). You can configure your analog I/O modules to access this clock and timestamp input data or output echo data when the module multicasts to the system. You decide how to timestamp data when you choose a Communication Format on the New Module dialog box. For more information, see page 205.

This feature provides accurate calculations between events to help you identify the sequence of events in either fault conditions or in the course of normal I/O operations. The system clock can be used between multiple modules in the same chassis.

In systems using an EtherNet/IP network and 1588 Grand Master time, the value of this timestamp still is the CST time. You must convert this CST value to Grand Master time in the controller.

Rolling Timestamp

Each module maintains a rolling timestamp that is unrelated to the CST. The rolling timestamp is a continuously running 15-bit timer that counts in milliseconds.

For input modules, whenever a module scans its channels, it also records the value of the rolling timestamp at that time. The user program can then use the last two rolling timestamp values and calculate the interval between receipt of data or the time when new data has been received.

For output modules, the rolling timestamp value is only updated when new values are applied to the Digital to Analog Converter (DAC).

Producer/Consumer Model

By using the Producer/Consumer model, ControlLogix I/O modules can produce data without having been polled by a controller first. The modules produce the data and any owner or listen-only controller device can decide to consume it.

For example, an input module produces data and any number of processors can consume the data at the same time. This eliminates the need for one processor to send the data to another processor.

Status Indicator Information

Each ControlLogix analog I/O module has status indicators on the front of the module that lets you check the module health and operational status of a module.

Status	Description
Calibration	Display indicates when your module is in the calibration mode.
Module	Display indicates the module's communication status.

For a list of status indicators and descriptions, see Troubleshoot Your Module on page 273.

Full Class I Division 2 Compliance

All ControlLogix analog I/O modules maintain CSA Class I Division 2 system certification. This allows the ControlLogix system to be placed in an environment other than only a 100% hazard free zone.

IMPORTANT Modules should not be pulled under power, nor should a powered RTB be removed, when a hazardous environment is present.

Agency Certification

Any ControlLogix analog I/O modules that have obtained various agency certifications are marked as such. Ultimately, all analog modules will have these agency approvals and will be marked accordingly.

Field Calibration

ControlLogix analog I/O modules let you calibrate on a channel-by-channel or module-wide basis. RSLogix 5000 software provides an interface to perform calibration.

For calibration procedures, see Chapter 11 on page 233.

Sensor Offset

You can add this offset directly to the input or output during calibration calculation. The purpose of this feature is to let you compensate for any sensor offset errors which may exist, such offset errors are common in thermocouple sensors.

To set a sensor offset, see page 210 in Chapter 10.

Latching of Alarms

The latching feature allows analog I/O modules to latch an alarm in the set position once it has been triggered, even if the condition causing the alarm to occur disappears.

Data Format

During initial configuration of any ControlLogix analog I/O module, you must choose a Communication Format. The format determines the data format of data exchanged between the owner-controller and the I/O module.

For example, if you use an integer data format with the 1756-OF6CI module, the clamping feature is not available for use.

Format type	Description
Integer	This mode uses a 16-bit signed format and allows faster sampling rates while using less memory in the controller but also limits the availability of features on your module. The faster sampling rates and lower memory usage vary according to module and application type. For more information on the specific sampling rates, see the Module Filter section in the module-specific chapters. Memory usage can be up to 50% less than in floating point.
Floating point	This mode uses a 32-bit IEEE floating point format and offers all module features.

TIP

We recommend that you use the floating point data format in most applications. Floating point is simpler to use. All ControlLogix analog I/O modules default to floating point when initialled configured.

You should use only the integer data format if your application requires faster sampling rates than offered in floating point or if your application memory is extremely limited.

Module Inhibiting

Module inhibiting lets you indefinitely suspend a connection between an owner-controller and an analog I/O module. This process can occur in either of the following ways:

- You write configuration for an I/O module but inhibit the module to prevent it from communicating with the owner-controller. In this case, the owner does not establish a connection and configuration is not sent to the module until the connection is uninhibited.
- In your application, a controller already owns a module and has downloaded configuration to the module and is currently exchanging data over the connection between the devices. In this case, you can inhibit the module and the owner-controller behaves as if the connection to the module does not exist.

IMPORTANT Whenever you inhibit an output module, it enters the Program mode and all outputs change to the state configured for the Program mode. For example, if an output module is configured so that the state of the outputs go to zero (0) during Program mode, whenever that module is inhibited, the outputs will go to zero (0).

The following examples are instances where you may need to use module inhibiting:

- Multiple controllers own the same analog input module. A change is required in the module's configuration; however, the change must be made to the program in all controllers. In this case, you can:

  a. Inhibit the module.
  b. Change configuration in all controllers.
  c. Uninhibit the module.

- You want to FLASH upgrade an analog I/O module. We recommend you:

  a. Inhibit the module.
  b. Perform the upgrade.
  c. Uninhibit the module.

- You are using a program that includes a module that you do not physically possess yet, but you do not want the controller to continually look for a module that does not exist yet. In this case, you can inhibit the module in your program until it physically resides in the proper slot.

Relationship Between Module Resolution, Scaling, and Data Format

The following three concepts listed below are closely related and must be explained in conjunction with each other.

- Module Resolution
- Scaling
- Data Format as Related to Resolution and Scaling

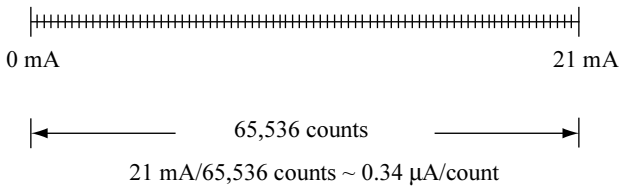
Module Resolution

Resolution is the smallest amount of change that the module can detect. Analog input modules are capable of 16-bit resolution. Output modules are capable of 13…16 bit resolution, depending on the module type.

The 16 bits represent 65,536 counts. This total is fixed but the value of each count is determined by the operational range you choose for your module.

For example, if you are using the 1756-IF6I module, your module's available current range equals 21 mA. Divide your range by the number of counts to figure out the value of each count. In this case, one count is approximately 0.34 µA.

Module Resolution



IMPORTANT A module's resolution is fixed. It will not change regardless of what data format you choose or how you decide to scale your module in floating point mode.

Resolution is based on the module hardware and the range selected. If you use a sensor with limited range, you do not change the module resolution.

The table lists the resolution for each module's range.

Current Values Represented in Engineering Units

Module	Range	Number of significant bits	Resolution
1756-IF16 and 1756-IF8	+/- 10.25V	16 bits	320 µV/count
	0…10.25V		160 µV/count
	0…5.125V		80 µV/count
	0…20.5 mA		0.32 µA/count
1756-IF6CIS	0 mA…21 mA	16 bits	0.34 µA/count
1756-IF6I	+/- 10.5V	16 bits	343 µV/count
	0…10.5V		171 µV/count
	0…5.25V		86 µV/count
	0…21 mA		0.34 µA/count
1756-IR6I	1…487 Ω	16 bits	7.7 MΩ/count
	2…1000 Ω		15 MΩ/count
	4…2000 Ω		30 MΩ/count
	8…4020 Ω		60 MΩ/count
1756-IT6I and 1756-IT6I2	-12…30 mV	16 bits	0.7 µV/count
	-12…78 mV		1.4 µV/count
1756-OF4 and 1756-OF8	+/- 10.4V	16 bits	320 µV/count
	0…21 mA	15 bits	0.65 µA/count
1756-OF6VI	+/- 10.5V	14 bits	1.3 mV
1756-OF6CI	0…21 mA	13 bits	2.7 µA

IMPORTANT Because these modules must allow for possible calibration inaccuracies, resolution values represent the available Analog to Digital or Digital to Analog counts over the specified range.

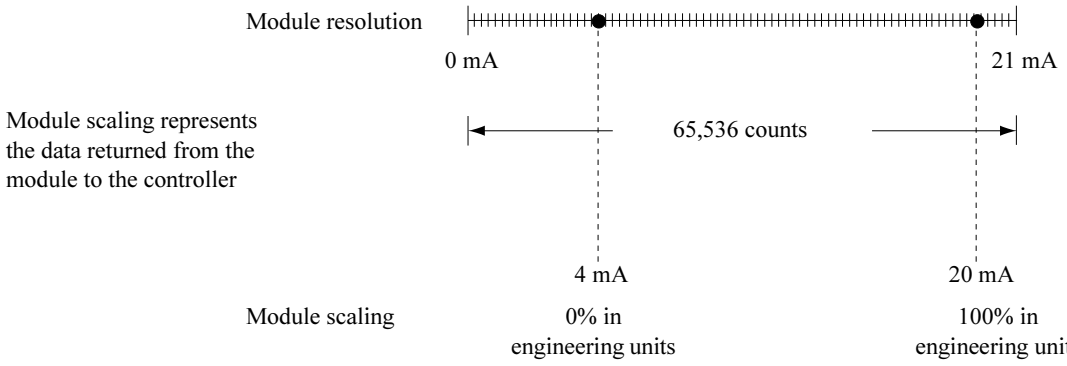
Scaling

With scaling, you change a quantity from one notation to another. For ControlLogix analog I/O modules, scaling is only available with the floating point data format.

When you scale a channel, you must choose two points along the module's operating range and apply low and high values to those points. For example, if you are using the 1756-IF6I module in current mode, the module maintains a 0…21 mA range capability. But your application may use a 4…20 mA transmitter. You can scale the module to represent 4 mA as the low signal and 20 mA as the high signal.

Scaling lets you configure the module to return data to the controller so that 4 mA returns a value of 0% in engineering units and 20 mA returns a value of 100% in engineering units.

Module Resolution Compared to Module Scaling



IMPORTANT In choosing two points for the low and high value of your application, you do not limit the range of the module. The module's range and its resolution remain constant regardless of how you scale it for your application.

The module may operate with values beyond the 4…20 mA range. If an input signal beyond the low and high signals is present at the module (that is, 3 mA), that data will be represented in terms of the engineering units set during scaling. The table shows example values that may appear based on the example mentioned above.

Current Values Represented in Engineering Units

Current	Engineering Units Value
3 mA	-6.25%
4 mA	0%
12 mA	50%
20 mA	100%
21 mA	106.25%

Data Format as Related to Resolution and Scaling

You can choose one of the following data formats for your application:

- Integer mode
- Floating point mode

Integer mode

This mode provides the most basic representation of analog data. When a module multicasts data in the integer mode, the low and high signals of the input range are fixed.

IMPORTANT Scaling is not available in integer mode. The low signal of your application range equals -32,768 counts while the high signal equals 32,767 counts.

In integer mode, input modules generate digital signal values that correspond to a range from -32,768…32,767 counts.

The table lists the conversions of a generated digital signal to the number of counts.

Input Signal to User Count Conversion

Input Module	Available Range	Low Signal and User Counts	High Signal and User Counts
1756-IF16/IF8	+/- 10V	-10.25V -32768 counts	10.25V 32767 counts
	0…10V	0V -32768 counts	10.25V 32767 counts
	0…5V	0V -32768 counts	5.125V 32767 counts
	0…20 mA	0 mA -32768 counts	20.58 mA 32767 counts
1756-IF6CIS	0…20 mA	0 mA -32768 counts	21.09376 mA 32767 counts
1756-IF6I	+/- 10V	-10.54688V -32768 counts	10.54688V 32767 counts
	0…10V	0V -32768 counts	10.54688V 32767 counts
	0…5V	0V -32768 counts	5.27344V 32767 counts
	0…20 mA	0 mA -32768 counts	21.09376 mA 32767 counts
1756-IR6I	1…487 Ω	0.859068653Ω -32768 counts	507.862Ω 32767 counts
	2…1000 Ω	2 Ω -32768 counts	1016.502 Ω 32767 counts
	4…2000 Ω	4 Ω -32768 counts	2033.780 Ω 32767 counts
	8…4020 Ω	8 Ω -32768 counts	4068.392 Ω 32767 counts
1756-IT6I and 1756-IT6I2	-12…30mV	-15.80323 mV -32768 counts	31.396 mV 32767 counts
	-12…78mV	-15.15836 mV -32768 counts	79.241 mV 32767 counts

Output modules let you generate an analog signal at the screw terminals that correspond to a range from -32,768…32,767 counts.

The table lists the conversions a generated digital signal to the number of counts.

Output Signal to User Count Conversion

Output Module	Available Range	Low Signal and User Counts	High Signal and User Counts
1756-OF4/OF8	0…20 mA	0 mA -32768 counts	21.2916 mA 32767 counts
	+/- 10V	-10.4336V -32768 counts	10.4336V 32767 counts
1756-OF6CI	0…20 mA	0 mA -32768 counts	21.074 mA 32767 counts
1756-OF6VI	+/- 10V	-10.517V -32768 counts	10.517V 32767 counts

Floating point mode

This mode lets you change the data representation of the selected module. Although the full range of the module does not change, you can scale your module to represent I/O data in terms specific for your application.

For example, if you are using the 1756-IF6I module in floating point mode and choose an input range of 0 mA…20 mA, the module can use signals within the range of 0 mA…21 mA but you can scale the module to represent data between 4 mA…20mA as the low and high signals in engineering units as shown on page 50.

For an example of how to define data representation in engineering units through RSLogix 5000 software, see page 210.

Difference Between Integer and Floating Point

The key difference between choosing integer mode or floating point mode is that the integer is fixed between -32,768…32,767 counts and floating point mode provides scaling to represent I/O data in specific engineering units for your application. Module resolution remains constant between the formats at 0.34 μA/count.

For example, the table shows the difference in the data returned from the 1756-IF6I module to the controller between data formats. In this case, the module uses the 0 mA…20 mA input range with 0 mA scaled to 0% and 20 mA scaled to 100%, as shown on page 50.

1756-IF6I Module using different data types

Signal Value	Fixed Number of Counts in Integer Mode	Data Representation in Floating Point Mode (Engineering Units)
0 mA	-32768 counts	-25%
4 mA	-20341 counts	0%
12 mA	4514 counts	50%
20 mA	29369 counts	100%
21.09376 mA	32767 counts	106.25%

Non-isolated Analog Voltage/Current Input Modules (1756-IF16, 1756-IF8)

Introduction

This chapter describes features specific to ControlLogix non-isolated, analog voltage/current input modules.

Topic	Page
Choose a Wiring Method	56
Choose a Data Format	58
Features Specific to Non-Isolated Analog Input Modules	59
Use Module Block and Input Circuit Diagrams	67
Wire the 1756-IF16 Module	70
Wire the 1756-IF8 Module	74
1756-IF16 Module Fault and Status Reporting	78
1756-IF8 Module Fault and Status Reporting	85

In addition to the features described in this chapter, the non-isolated analog voltage/current input modules support all features described in Chapter 3. The table lists additional features that your non-isolated analog voltage/current input modules support.

Additional Features for Non-Isolated Analog Input Modules

Feature	Page
Removal and Insertion Under Power (RIUP)	36
Module Fault Reporting	36
Configurable Software	36
Electronic Keying	37
Access to System Clock for Timestamp Functions	44
Rolling Timestamp	44
Producer/Consumer Model	44
Status Indicator Information	45
Full Class I Division 2 Compliance	45
Agency Certification	45
Field Calibration	45
Sensor Offset	46
Latching of Alarms	46

Choose a Wiring Method

The 1756-IF16 and 1756-IF8 modules support these wiring methods:

- Single-ended Wiring Method
- Differential Wiring Method
- High-speed Mode Differential Wiring Method

After determining the wiring method you will use on your module, you must inform the system of that choice when you choose a Communication Format. For more information, page 205

For examples of each wiring format on the 1756-IF16 module, see the examples beginning on page 70. For examples of each wiring format on the 1756-IF8 module, see the examples beginning on page 74.

Single-ended Wiring Method

Single-ended wiring compares one side of the signal input to signal ground. This difference is used by the module in generating digital data for the controller.

When using the single-ended wiring method, all input devices are tied to a common ground. In addition to the common ground, the use of single-ended wiring maximizes the number of usable channels on the module (eight channels for the 1756-IF8 module and 16 channels for the 1756-IF16).

Differential Wiring Method

The differential wiring method is recommended for applications that may have separate signal pairs or a common ground is not available. Differential wiring is recommended for environments where improved noise immunity is needed.

IMPORTANT This wiring method lets you use only half a module's channels. For example, you can use only eight channels on the 1756-IF16 module and four channels on the 1756-IF8 module.

In differential mode, the channels are not totally isolated from each other. If multiple differential input signals have different voltage common references, one channel could affect the reading of another channel. If this condition cannot be avoided, then wire these inputs on different modules or replace the non-isolated module with an isolated input module.

High-speed Mode Differential Wiring Method

You can configure the 1756-IF16 and 1756-IF8 modules for a high-speed mode that will give you the fastest data updates possible. When using the high-speed mode, remember these conditions:

- This mode uses the differential wiring method.
- This mode only allows use of one out of every four channels on the module.

Update times for applications using the high-speed mode can be found on page 60.

Choose a Data Format

Data format determines the format of the data returned from the module to the owner-controller and the features that are available to your application. You choose a data format when you choose a Communication Format.

When you choose a Communication Format, you can select one of two data formats:

- Integer mode
- Floating point mode

The table shows features that are available in each format.

Data Format	Features Available	Features Not Available
Integer mode	Multiple input ranges Module filter Real time sampling	Process alarms Digital filtering Rate alarms Scaling
Floating point mode	All features	See below

IMPORTANT When using the 1756-IF16 module in single-ended mode (that is, 16-channel mode) with a floating point data format, process alarms and rate alarms are not available.

This condition exists when the 1756-IF16 is only wired for single-ended mode. The 1756-IF8 is not affected.

Features Specific to Non-Isolated Analog Input Modules

The table lists features that are specific to the 1756-IF16 and 1756-IF8 modules.

Feature	Page
Multiple Input Ranges	59
Module Filter	60
Real Time Sampling	61
Underrange/Overrange Detection	61
Digital Filter	62
Process Alarms	63
Rate Alarm	64
Wire Off Detection	64

Multiple Input Ranges

You can select from a series of operational ranges for each channel on your module. The range designates the **minimum** and **maximum signals** that are detectable by the module.

Module	Possible Ranges
1756-IF16 and 1756-IF8	-10…10V 0…5V 0…10V 0…20 mA

See page 210 for an example of how to choose an input range for your module.

Module Filter

The module filter is a built-in feature of the analog-to-digital convertor that attenuates the input signal beginning at the specified frequency. This feature is applied on a module-wide basis.

The module attenuates the selected frequency by approximately -3dB or 0.707 of the applied amplitude. This selected frequency is also called the bandwidth of the module.

An input signal with frequencies above the selected frequency will be attenuated more, while frequencies below the selection will receive no attenuation.

In addition to frequency rejection, a by-product of the filter selection is the minimum sample rate (RTS) that is available. For example, in floating point mode, the 1000 Hz selection will not attenuate any frequencies less than 1000 Hz, but will allow sampling of all 16 channels within 18 ms. But the 10 Hz selection attenuates all frequencies above 10 Hz and allows only sampling of all 16 channels within 488 ms.

IMPORTANT The default setting for the module filter is 60 Hz. This setting provides approximately 3 dB of filtering of a 60 Hz input.

Use the following table to choose a module filter setting.

Filter Selections with Associated Performance Data

Module Filter Setting (-3dB)[1] [2]	Wiring Mode	10 Hz	50…60 Hz (Default)	100 Hz	250 Hz	1000 Hz
Minimum sample time (RTS)	Single-ended	488 ms	88 ms	56 ms	28 ms	16 ms
Integer mode	Differential	244 ms	44 ms	28 ms	14 ms	8 ms
	High-speed differential	122 ms	22 ms	14 ms	7 ms	5 ms
Minimum sample time (RTS)	Single-ended	488 ms	88 ms	56 ms	28 ms	18 ms
Floating point mode	Differential	244 ms	44 ms	28 ms	14 ms	11 ms
	High-speed differential	122 ms	22 ms	14 ms	7 ms	6 ms
Effective resolution		16 bits	16 bits	16 bits	14 bits	12 bits

(1) For optimal 50…60 Hz noise rejection (>80dB), choose the 10 Hz filter.

(2) Worst case setting time to 100% of a step change is double the RTS sample times.

Real Time Sampling

This parameter instructs the module how often to scan its input channels and obtain all available data. After the channels are scanned, the module multicasts that data. This feature is applied on a module-wide basis.

During module configuration, you specify a real time sampling (RTS) period and a requested packet interval (RPI) period. Both of these features instruct the module to multicast data, but only the RTS feature instructs the module to scan its channels before multicasting.

Underrange/Overrange Detection

This alarm feature detects when the non-isolated input module is operating beyond limits set by the input range. For example, if you are using the 1756-IF16 module in the 0V…10V input range and the module voltage increases to 11V, the overrange detects this condition.

The table shows the input ranges of non-isolated input modules and the lowest/highest signal available in each range before the module detects an underrange/overrange condition.

Input Module	Available Range	Lowest Signal in Range	Highest Signal in Range
1756-IF16 and 1756-IF8	+/- 10V	-10.25V	10.25V
	0V…10V	0V	10.25V
	0V…5V	0V	5.125V
	0 mA…20 mA	0 mA	20.58 mA

IMPORTANT Be careful when 'disabling all alarms' on the channel because it also disables the underrange/overrange detection feature. If alarms are disabled, overrange/underrange is zero and the only way you can discover a wire-off detection is from the input value itself. If you need to detect a wire-off status, do not 'disable all alarms'.

We recommend that you disable only unused channels so extraneous alarm bits are not set.

Digital Filter

The digital filter smooths input data noise transients for all channels on the module. This feature is applied on a per channel basis.

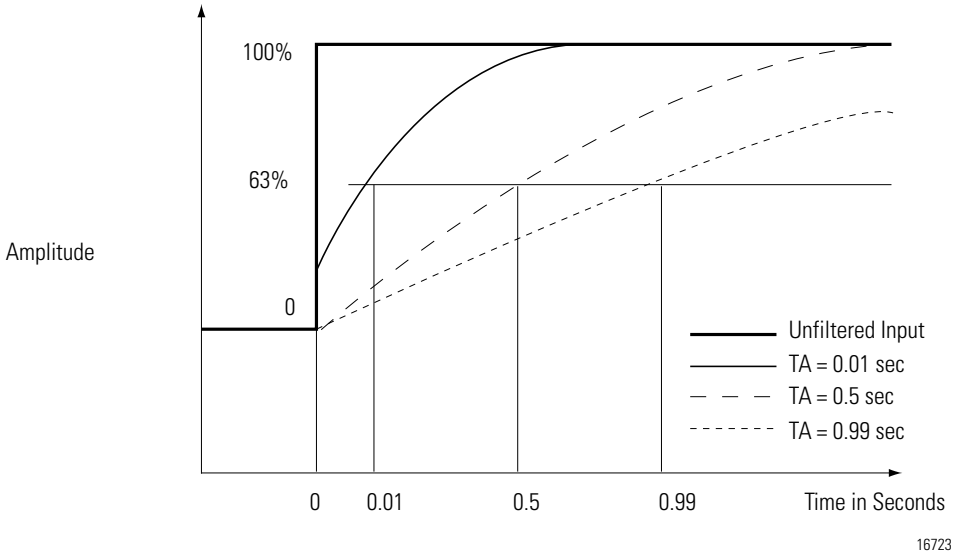
The digital filter value specifies the time constant for a digital first order lag filter on the input. It is specified in units of milliseconds. A value of 0 disables the filter.

The digital filter equation is a classic first order lag equation.

$$Yn = Yn\text{-}1 + \frac{[\Delta t]}{\Delta t + TA} (X_n - Y_n\text{-}1)$$

Yn = Present output, filtered peak voltage (PV)
Yn-1 =Previous output, filtered PV
Δt = Module channel update time (seconds)
TA = Digital filter time constant (seconds)
Xn = Present input, unfiltered PV

Using a step input change to illustrate the filter response, as shown in the illustration, you can see that when the digital filter time constant elapses, 63.2% of the total response is reached. Each additional time constant achieves 63.2% of the remaining response.



To see how to set the Digital Filter, see page 210.

Process Alarms

Process alarms alert you when the module has exceeded configured high or low limits for each channel. You can latch process alarms. These are set at four user configurable alarm trigger points.

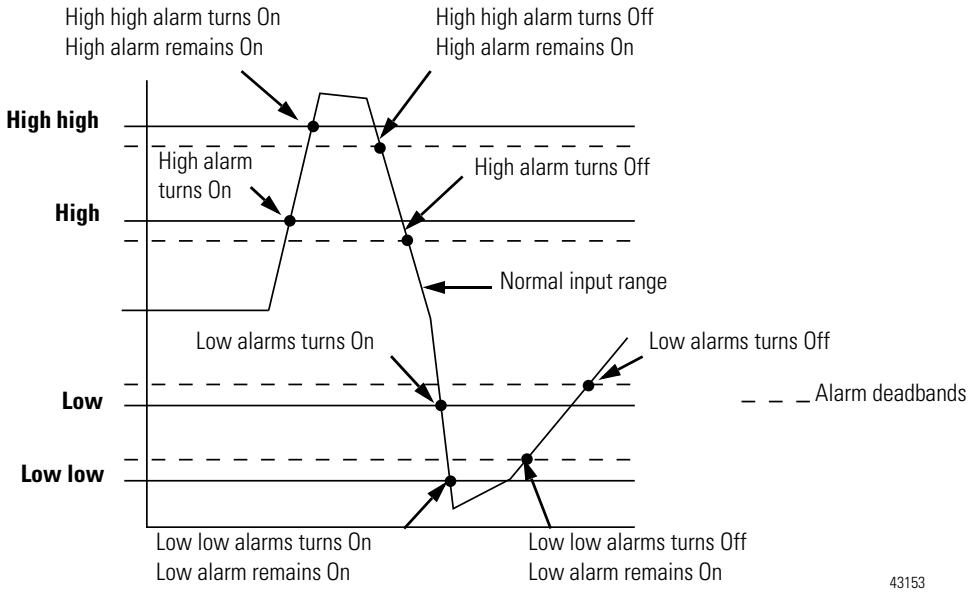
- High high
- High
- Low
- Low low

IMPORTANT Process alarms are not available in integer mode or in applications using 1756-IF16 module in the single-ended, floating point mode. The values for each limit are entered in scaled engineering units.

Alarm Deadband

You may configure an alarm deadband to work with the process alarms. The deadband allows the process alarm status bit to remain set, despite the alarm condition disappearing, as long as the input data remains within the deadband of the process alarm.

The illustration on the next page shows input data that sets each of the four alarms at some point during module operation. In this example, latching is disabled; therefore, each alarms turns Off when the condition that caused it to set ceases to exist.



To see how to set Process Alarms, see page 212.

Rate Alarm

The rate alarm triggers if the rate of change between input samples for each channel exceeds the specified trigger point for that channel.

IMPORTANT Rate alarms are not available in integer mode or in applications using 1756-IF16 module in the single-ended, floating point mode. The values for each limit are entered in scaled engineering units.

For example, if you set the 1756-IF16 module (with normal scaling in volts) to a rate alarm of 1.0 V/S, the rate alarm will only trigger if the difference between measured input samples changes at a rate > 1.0 V/S.

If the module's RTS is 100 ms that is, sampling new input data every 100 ms) and at time 0, the module measures 5.0 volts and at time 100 ms measures 5.08 V, the rate of change is (5.08V - 5.0V) / (100 mS) = 0.8 V/S. The rate alarm would not set as the change is less than the trigger point of 1.0V/s.

If the next sample taken is 4.9V, the rate of change is (4.9V…5.08V)/ (100 mS)=-1.8V/S. The absolute value of this result is > 1.0V/S, so the rate alarm will set. Absolute value is applied because rate alarm checks for the magnitude of the rate of change being beyond the trigger point, whether a positive or negative excursion.

Wire Off Detection

The 1756-IF16 and 1756-IF8 modules will alert you when a signal wire only has been disconnected from one of its channels or the RTB has been removed from the module. When a wire-off condition occurs for this module, two events occur:

- Input data for that channel changes to a specific scaled value.
- A fault bit is set in the owner-controller that may indicate the presence of a wire-off condition.

Because the 1756-IF16 and 1756-IF8 modules can be applied in voltage or current applications, differences exist as to how a wire-off condition is detected in each application.

IMPORTANT Be careful when 'disabling all alarms' on the channel because it also disables the underrange/overrange detection feature. If alarms are disabled, overrange/underrange is zero and the only way you can discover a wire-off detection is from the input value itself. If you need to detect a wire-off status, do not 'disable all alarms'.

We recommend that you disable only unused channels so extraneous alarm bits are not set.

The table lists the differences that occur when a wire-off condition occurs in various applications.

Wire-Off Conditions

When the Wire-Off condition occurs	These events occur
Single-ended Voltage Applications	• Input data for odd numbered channels changes to the scaled value associated with the underrange signal value of the selected operational range in floating point mode (minimum possible scaled value) or -32,767 counts in integer mode. • The ChxUnderrange (x = channel number) tag is set to 1. • Input data for even numbered channels changes to the scaled value associated with the overrange signal value of the selected operational range in floating point mode (maximum possible scaled value) or 32,767 counts in integer mode. • The ChxOverrange (x= channel number) tag[(1)] is set to 1.
Single-Ended Current	• Input data for that channel changes to the scaled value associated with the underrange signal value of the selected operational range in floating point mode (minimum possible scaled value) or -32,768 counts in integer mode. • The ChxUnderrange (x= channel number) tag is set to 1.
Differential Voltage	• Input data for that channel changes to the scaled value associated with the overrange signal value of the selected operational range in floating point mode (maximum possible scaled value) or 32,768 counts in integer mode. • The ChxOverrange (x= channel number) tag is set to 1.

Wire-Off Conditions

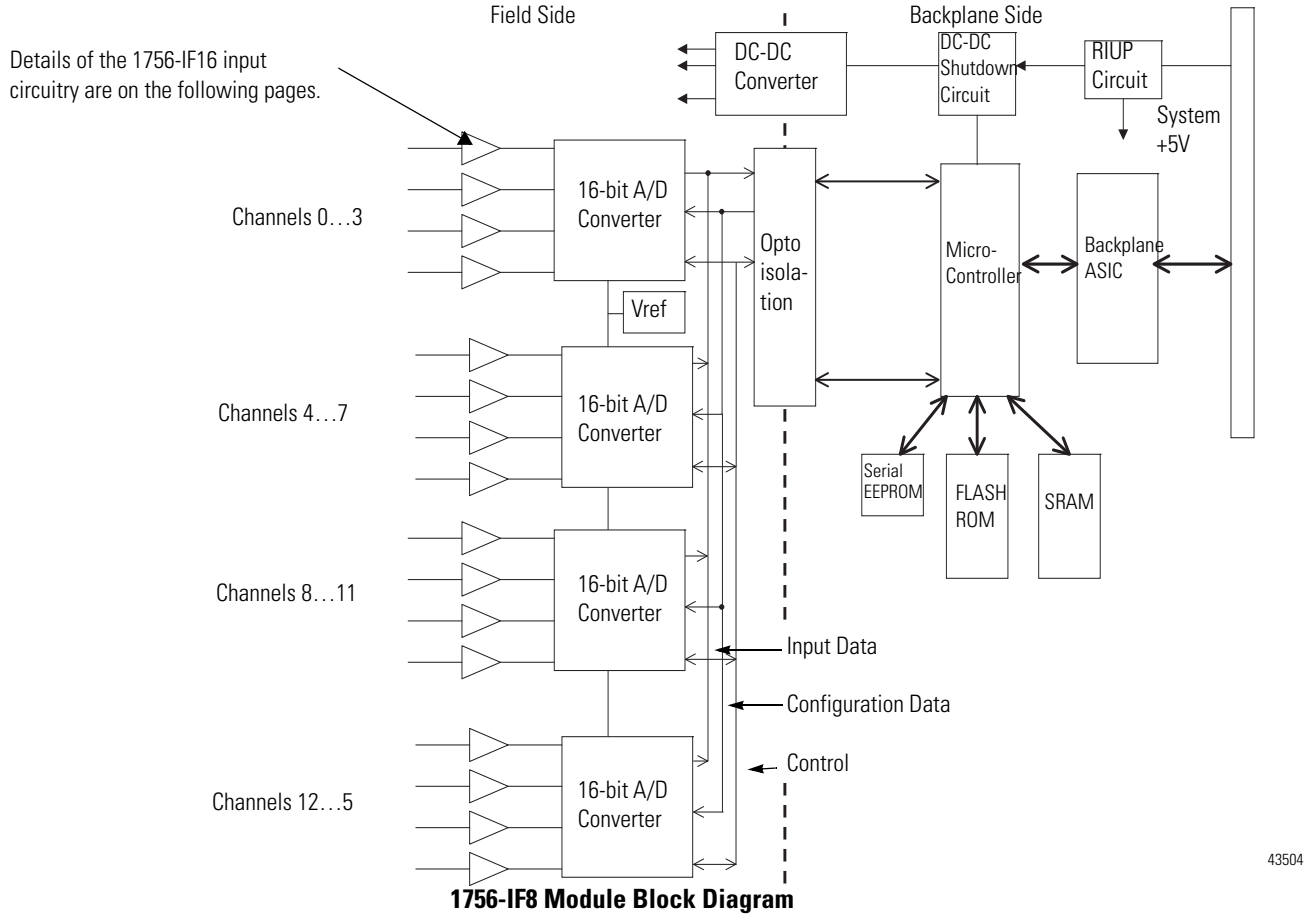
When the Wire-Off condition occurs	These events occur
Differential Current Applications	• Input data for that channel changes to the scaled value associated with the overrange signal value of the selected operational range in floating point mode (minimum possible scaled value) or -32,768 counts in integer mode. • The ChxUnderrange (x=channel number) tag is set to 1. In current applications, wire-off detection occurs for one of the following reasons: • Because the RTB has been disconnected from the module. • Both the signal wire and the jumper wire have been disconnected. The module reacts with the same conditions as described in differential voltage applications.

(1) For more information about tags in the tag editor, see Appendix B.

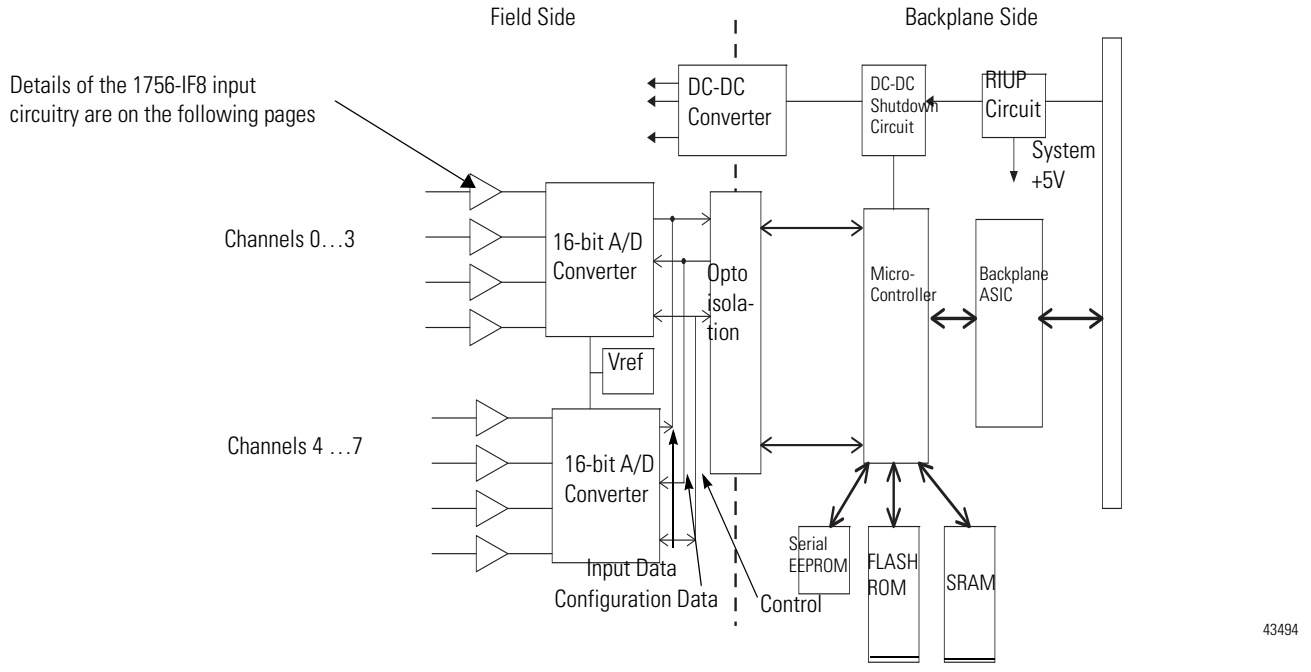
Use Module Block and Input Circuit Diagrams

This section shows the 1756-IF16 and 1756-IF8 modules' block diagrams and input circuit diagrams.

1756-IF16 Module Block Diagram



1756-IF8 Module Block Diagram

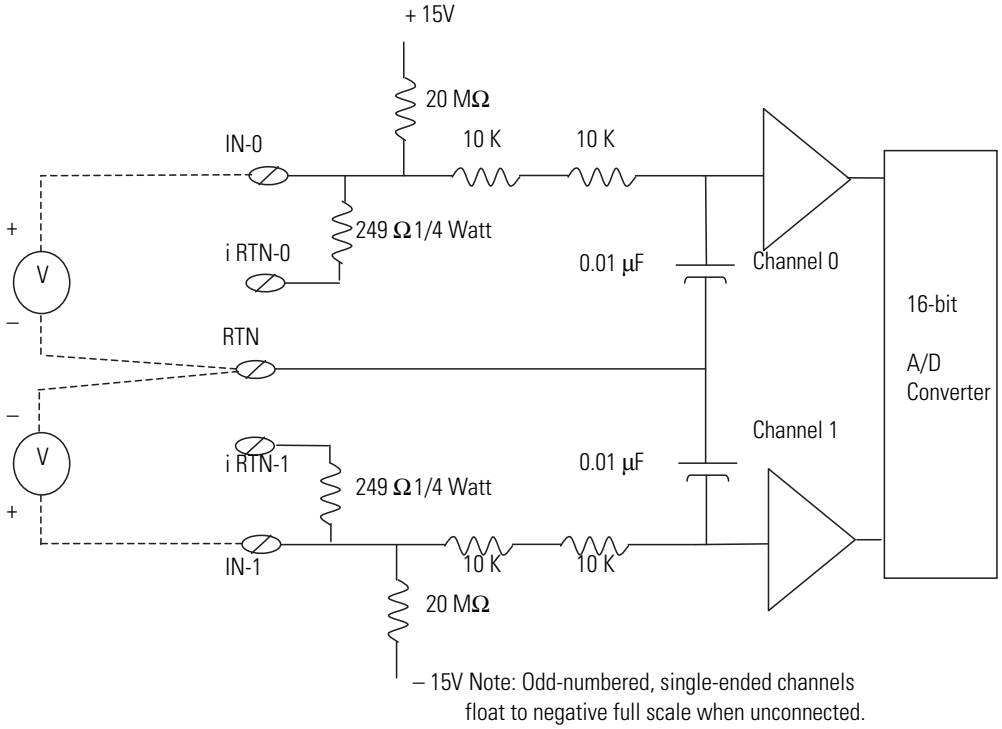


Field-side Circuit Diagrams

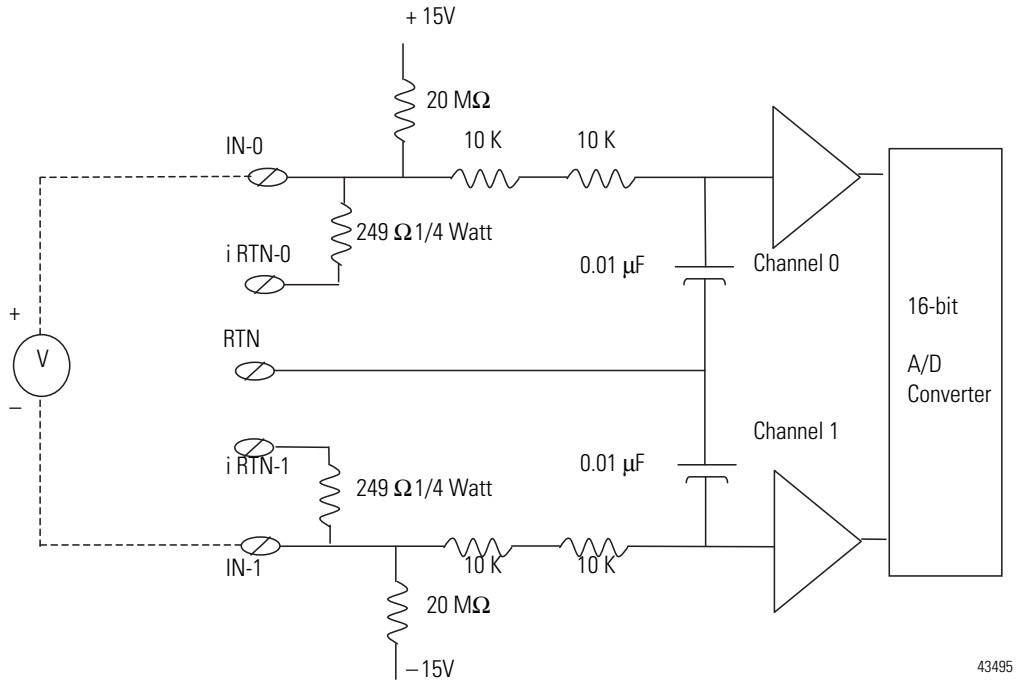
The field-side circuit diagrams are the same for both the 1756-IF16 and 1756-IF8 modules.

1756-IF16 and 1756-IF8 Voltage Input Circuit

Single-ended Voltage Inputs

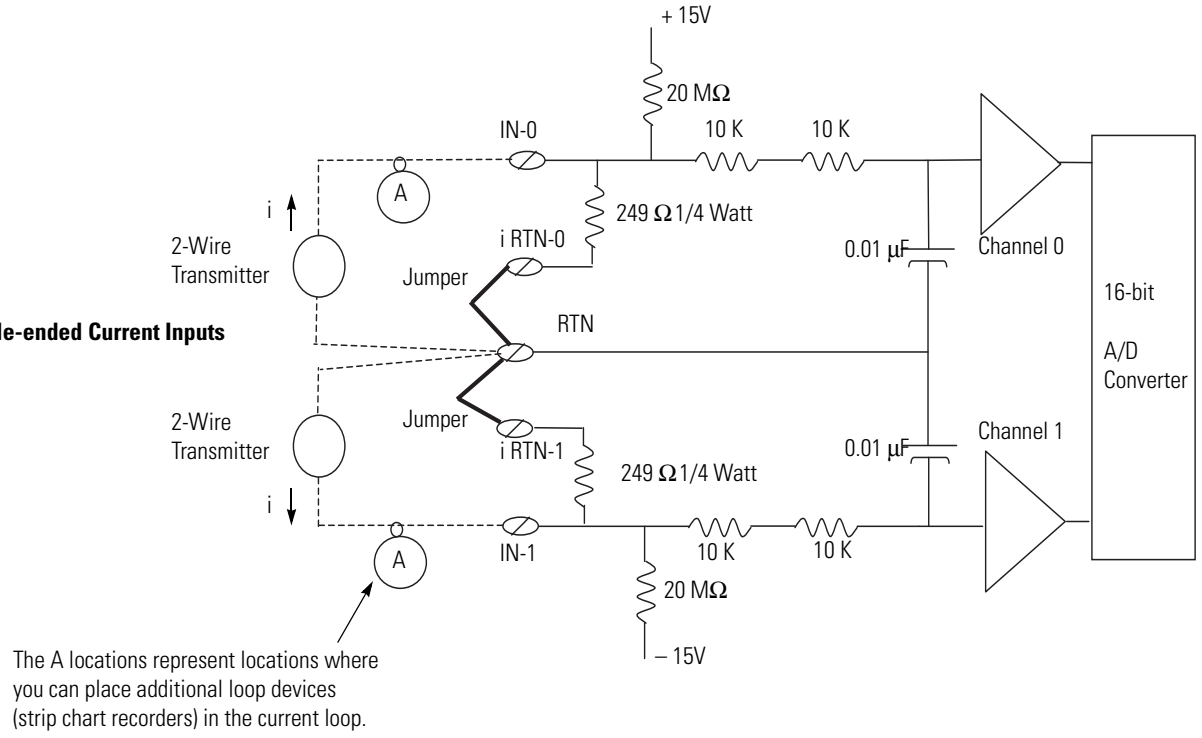


Differential Voltage Inputs



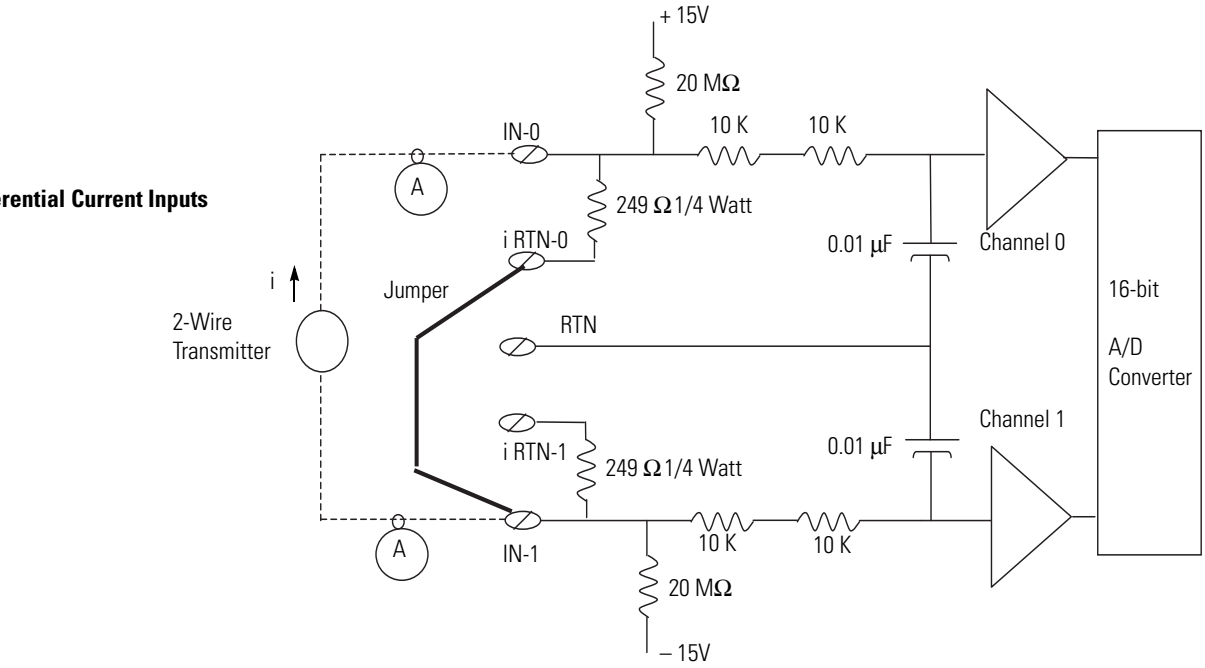
1756-IF16 and 1756-IF8 Current Input Circuit

Single-ended Current Inputs



The A locations represent locations where you can place additional loop devices (strip chart recorders) in the current loop.

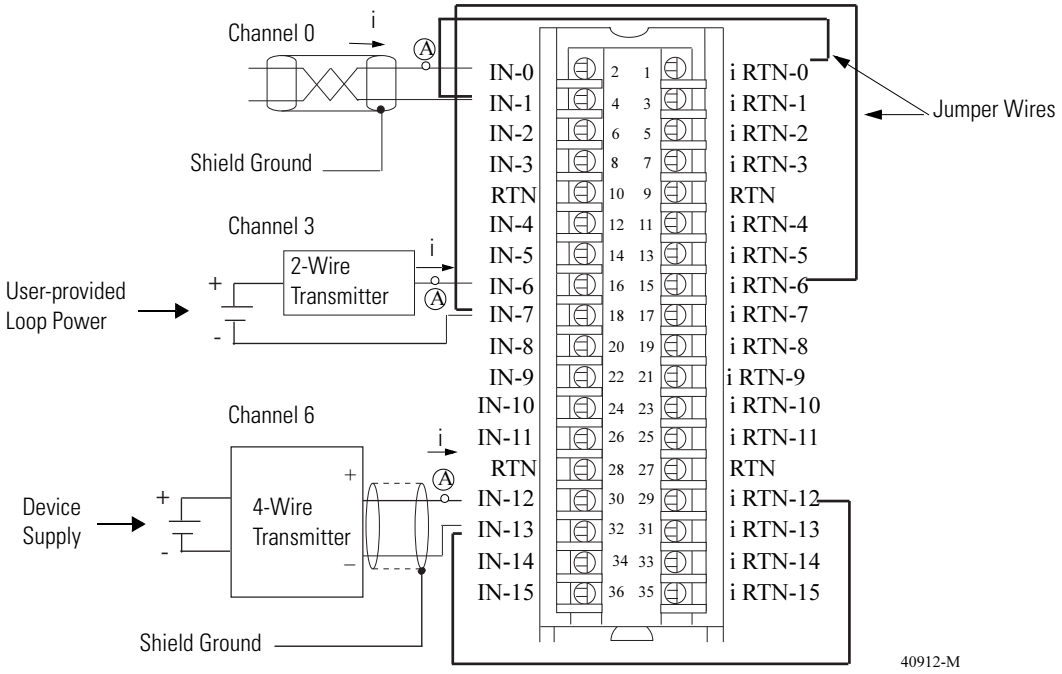
Differential Current Inputs



Wire the 1756-IF16 Module

Current and voltage wiring examples for the 1756-IF16 module are shown on the following pages.

1756-IF16 Differential Current Wiring Example.



NOTES:

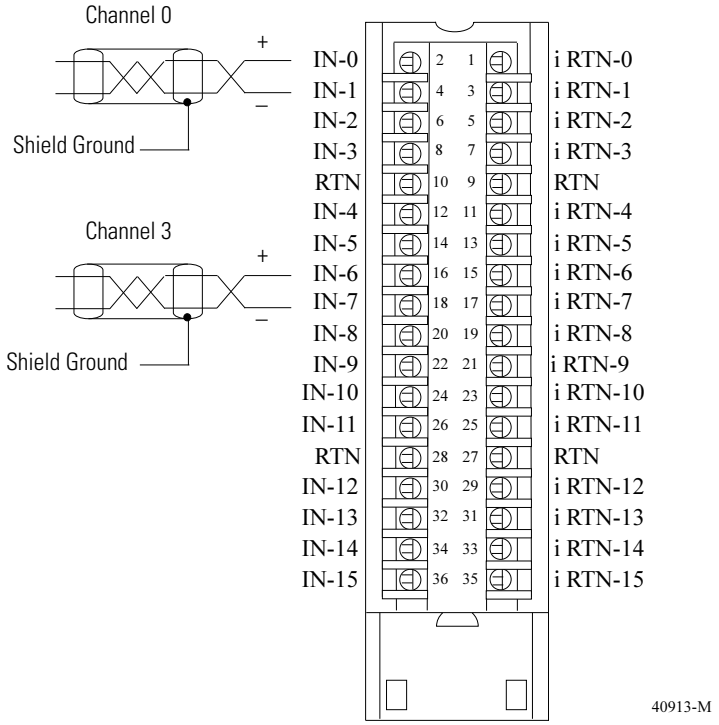
1. Use the table when wiring your module in differential mode

Channel	Terminals	Channel	Terminals
Channel 0	IN-0 (+), IN-1 (-) & i RTN-0	Channel 4	IN-8 (+), IN-9 (-) & i RTN-8
Channel 1	IN-2 (+), IN-3 (-) & i RTN-2	Channel 5	IN-10 (+), IN-11 (-) & i RTN-10
Channel 2	IN-4 (+), IN-5 (-) & i RTN-4	Channel 6	IN-12 (+), IN-13 (-) & i RTN-12
Channel 3	IN-6 (+), IN-7 (-) & i RTN-6	Channel 7	IN-14 (+), IN-15 (-) & i RTN-14

2. All terminals marked RTN are connected internally.
3. A 249 Ω current loop resistor is located between IN-x and i RTN-x terminals.
4. If multiple (+) or multiple (-) terminals are tied together, connect that tie point to a RTN terminal to maintain the module's accuracy.
5. Place additional loop devices (strip chart recorders, so forth) at the A location in the current loop.
6. Do not connect more than two wires to any single terminal.

IMPORTANT: When operating in four channel, high-speed mode, only use channels 0, 2, 4 and 6.

1756-IF16 Differential Voltage Wiring Example



NOTES:

1. Use the table when wiring your module in differential mode

Channel	Terminals	Channel	Terminals
Channel 0	IN-0 (+) & IN-1 (-)	Channel 4	IN-8 (+) & IN-9 (-)
Channel 1	IN-2 (+) & IN-3 (-)	Channel 5	IN-10 (+) & IN-11 (-)
Channel 2	IN-4 (+) & IN-5 (-)	Channel 6	IN-12 (+) & IN-13 (-)
Channel 3	IN-6 (+) & IN-7 (-)	Channel 7	IN-14 (+) & IN-15 (-)

2. All terminals marked RTN are connected internally.

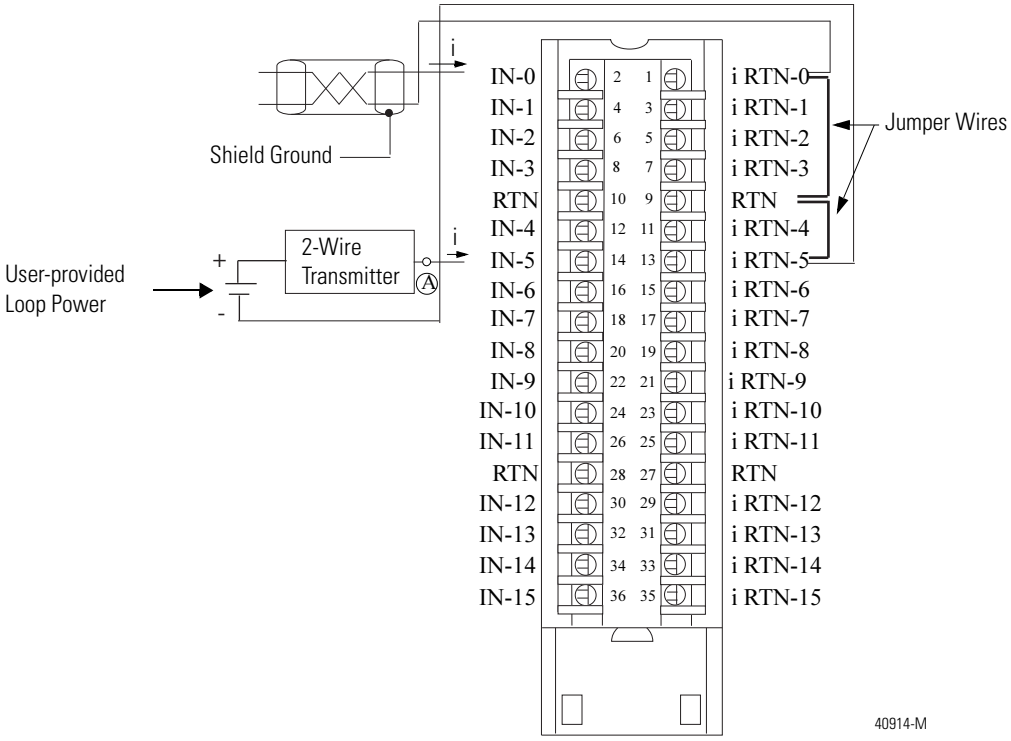
3. If multiple (+) or multiple (-) terminals are tied together, connect that tie point to a RTN terminal to maintain the module's accuracy.

4. Terminals marked RTN or iRTN are not used for differential voltage wiring.

5. Do not connect more than two wires to any single terminal.

IMPORTANT: When operating in four channel, high-speed mode, only use channels 0, 2, 4 and 6.

1756-IF16 Single-ended Current Wiring Example



NOTES:

1. All terminals marked RTN are connected internally.

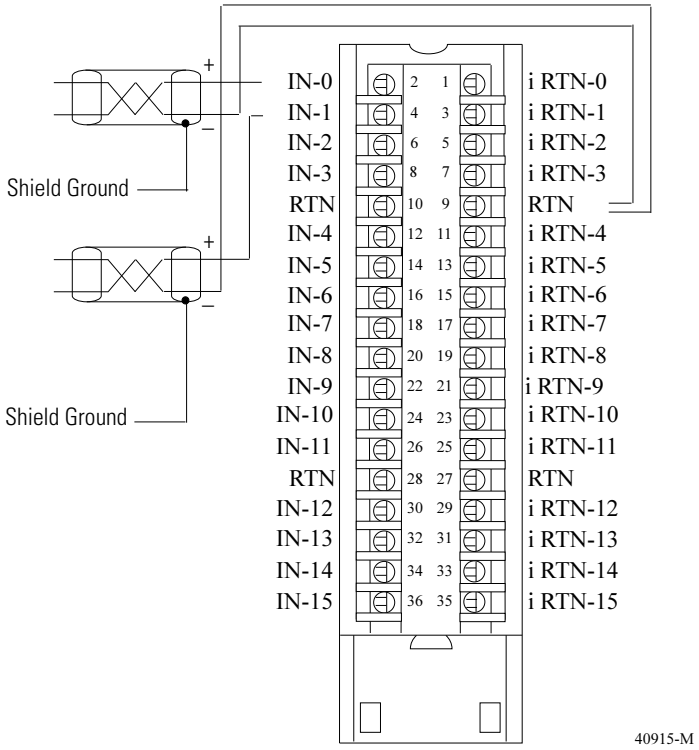
2. For current applications, all terminals marked iRTN must be wired to terminals marked RTN.

3. A 249 Ωcurrent loop resistor is located between IN-x and i RTN-x terminals.

4. Place additional loop devices (strip chart recorders, so forth) at the A location in the current loop.

5. Do not connect more than two wires to any single terminal.

1756-IF16 Single-ended Voltage Wiring Example



NOTES:

1. All terminals marked RTN are connected internally.

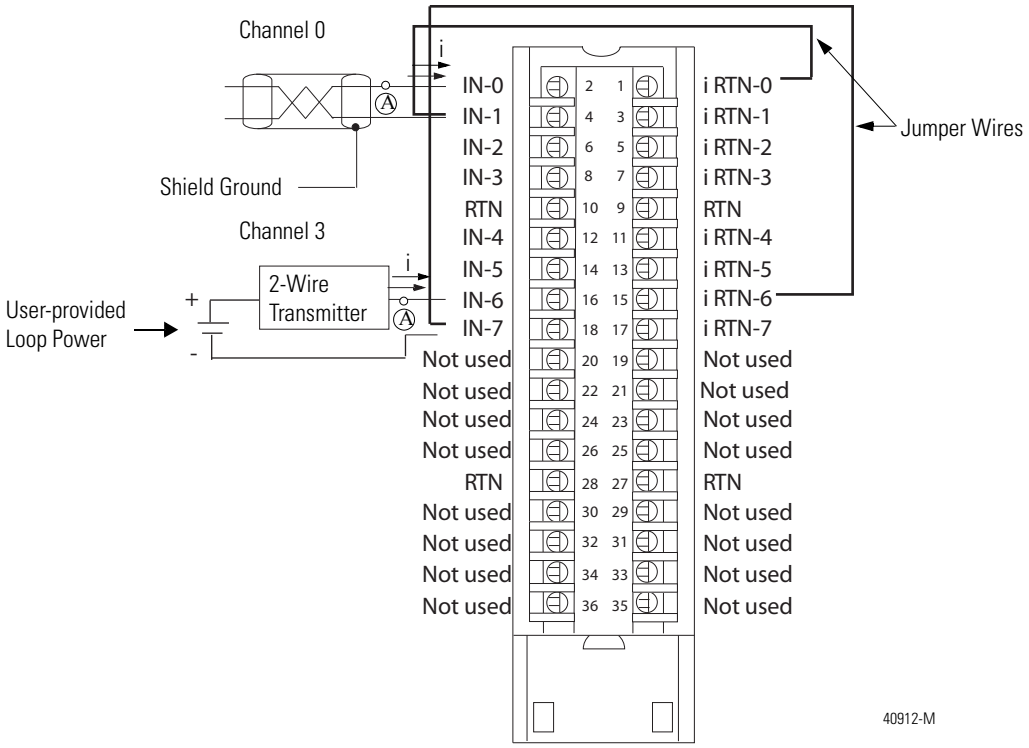
2. Terminals marked iRTN are not used for single-ended voltage wiring.

3. Do not connect more than two wires to any single terminal.

Wire the 1756-IF8 Module

Current and voltage wiring examples for the 1756-IF8 module are shown on the following pages.

1756-IF8 Differential Current Wiring Example - 4 channels.



NOTES:

1. Use the table when wiring your module in differential mode

Channel	Terminals
Channel 0	IN-0 (+), IN-1 (-) & i RTN-0
Channel 1	IN-2 (+), IN-3 (-) & i RTN-2
Channel 2	IN-4 (+), IN-5 (-) & i RTN-4
Channel 3	IN-6 (+), IN-7 (-) & i RTN-6

2. All terminals marked RTN are connected internally.

3. A 249 Ω current loop resistor is located between IN-x and i RTN-x terminals.

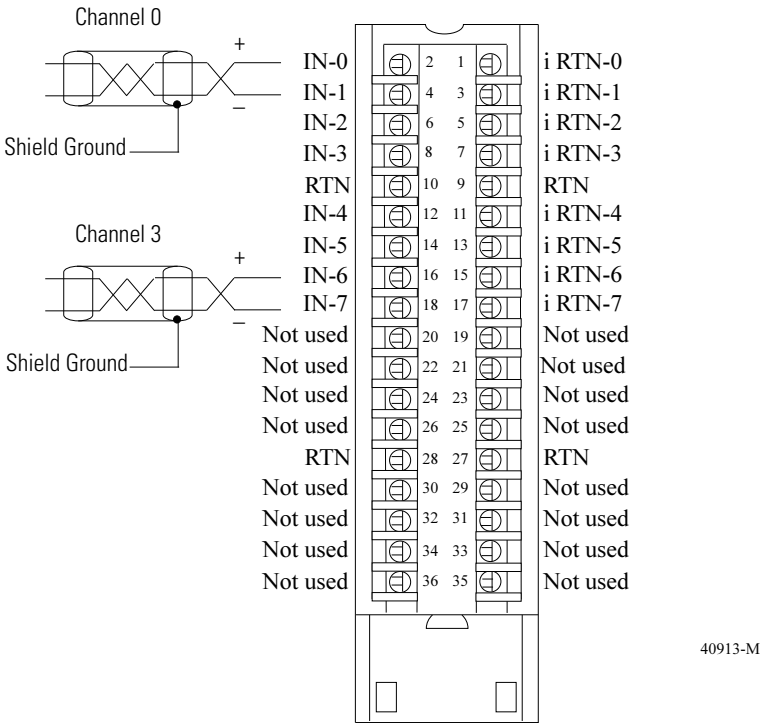
4. If multiple (+) or multiple (-) terminals are tied together, connect that tie point to a RTN terminal to maintain the module's accuracy.

5. Place additional loop devices (strip chart recorders, so forth) at the A location in the current loop.

6. Do not connect more than two wires to any single terminal.

IMPORTANT: When operating in two channel, high-speed mode, only use channels 0 and 2.

1756-IF8 Differential Voltage Wiring Example - 4 Channels



NOTES:

1. Use the table when wiring your module in differential mode

Channel	Terminals
Channel 0	IN-0 (+) & IN-1 (-)
Channel 1	IN-2 (+) & IN-3 (-)
Channel 2	IN-4 (+) & IN-5 (-)
Channel 3	IN-6 (+) & IN-7 (-)

2. All terminals marked RTN are connected internally.

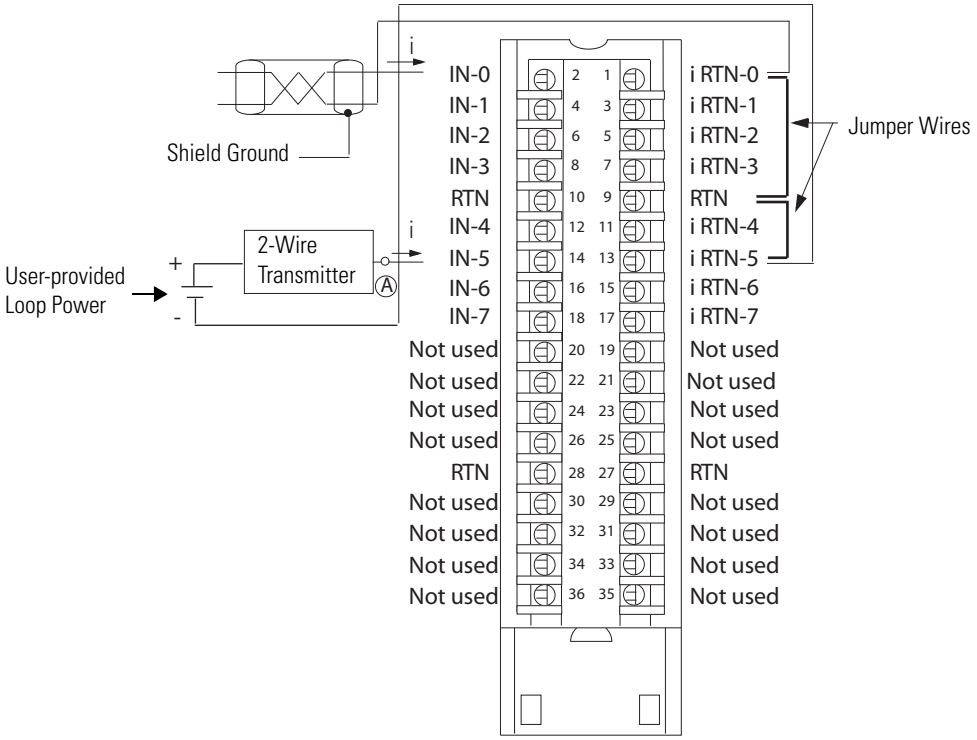
3. If multiple (+) or multiple (-) terminals are tied together, connect that tie point to a RTN terminal to maintain the module's accuracy.

4. Terminals marked RTN or iRTN are not used for differential voltage wiring.

5. Do not connect more than two wires to any single terminal.

IMPORTANT: When operating in two channel, high-speed mode, only use channels 0 and 2.

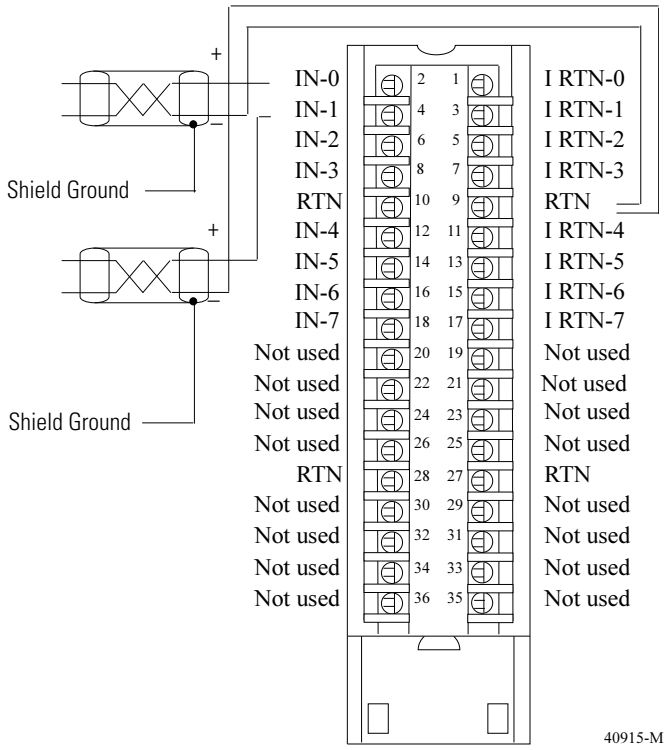
1756-IF8 Single-ended Current Wiring Example



NOTES:

1. All terminals marked RTN are connected internally.
2. For current applications, all terminals marked iRTN must be wired to terminals marked RTN.
3. A 249 Ω current loop resistor is located between IN-x and i RTN-x terminals.
4. Place additional loop devices (strip chart recorders, so forth) at the A location in the current loop.
5. Do not connect more than two wires to any single terminal.

1756-IF8 Single-ended Voltage Wiring Example



NOTES:

1. All terminals marked RTN are connected internally.
2. Terminals marked iRTN are not used for single-ended voltage wiring.
3. Do not connect more than two wires to any single terminal.

1756-IF16 Module Fault and Status Reporting

The 1756-IF16 module multicasts status and fault data to the owner/listening controller with its channel data. The fault data is arranged in such a manner as to let you choose the level of granularity for examining fault conditions.

Three levels of tags work together to provide an increasing degree of detail as to the specific cause of faults on the module.

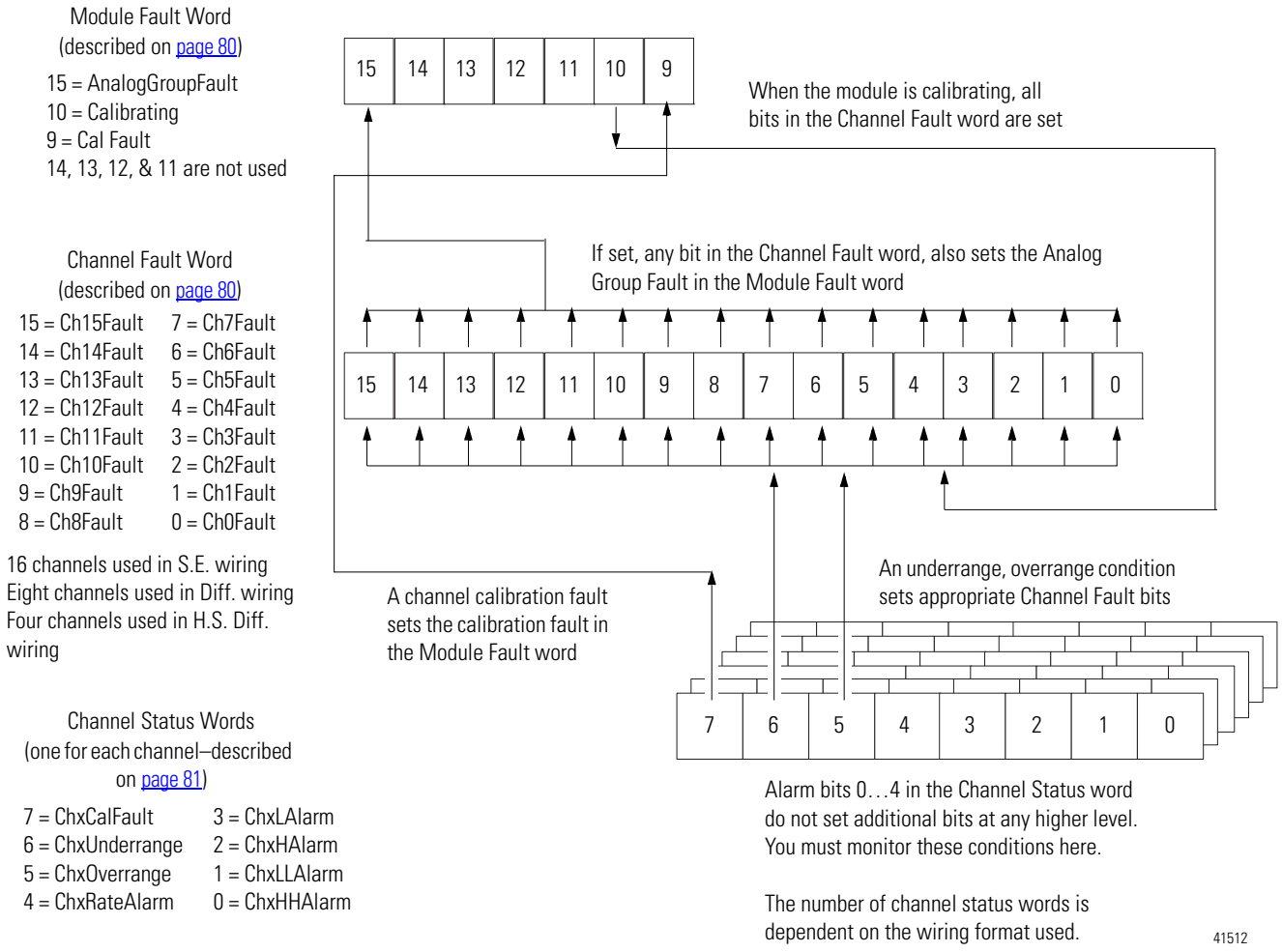
The table lists tags that can be examined in ladder logic to indicate when a fault has occurred:

Tag	Description
Module Fault Word	This word provides fault summary reporting. Its tag name is ModuleFaults.
Channel Fault Word	This word provides underrange, overrange and communication fault reporting. Its tag name is ChannelFaults. When examining the Channel Fault Word for faults, remember the following: • 16 channels are used in single-ended wiring. • Eight channels are used in differential wiring. • Four channels are used in high-speed differential wiring. • All bytes start with bit 0.
Channel Status Words	These words, one per channel, provide individual channel underrange and overrange fault reporting for process alarms, rate alarms, and calibration faults. Its tag name is ChxStatus.

IMPORTANT Differences exist between floating point and integer modes as they relate to module fault reporting. These differences are explained in the following two sections.

1756-IF16 Fault Reporting in Floating Point Mode

The illustration is an example of the fault reporting process for the 1756-IF16 module in floating point mode.


Module Fault Word
(described on page 80)
15 = AnalogGroupFault
10 = Calibrating
9 = Cal Fault
14, 13, 12, & 11 are not used
15 14 13 12 11 10 9
When the module is calibrating, all bits in the Channel Fault word are set
Channel Fault Word
(described on page 80)
15 = Ch15Fault 7 = Ch7Fault
14 = Ch14Fault 6 = Ch6Fault
13 = Ch13Fault 5 = Ch5Fault
12 = Ch12Fault 4 = Ch4Fault
11 = Ch11Fault 3 = Ch3Fault
10 = Ch10Fault 2 = Ch2Fault
9 = Ch9Fault 1 = Ch1Fault
8 = Ch8Fault 0 = Ch0Fault
If set, any bit in the Channel Fault word, also sets the Analog Group Fault in the Module Fault word
15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
16 channels used in S.E. wiring
Eight channels used in Diff. wiring
Four channels used in H.S. Diff. wiring
A channel calibration fault sets the calibration fault in the Module Fault word
An underrange, overrange condition sets appropriate Channel Fault bits
Channel Status Words
(one for each channel–described on page 81)
7 = ChxCalFault 3 = ChxLAlarm
6 = ChxUnderrange 2 = ChxHAlarm
5 = ChxOverrange 1 = ChxLLAlarm
4 = ChxRateAlarm 0 = ChxHHAlarm
7 6 5 4 3 2 1 0
Alarm bits 0…4 in the Channel Status word do not set additional bits at any higher level. You must monitor these conditions here.
The number of channel status words is dependent on the wiring format used.
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1756-IF16 Module Fault Word Bits – Floating Point Mode

Bits in this word provide the highest level of fault detection. A non-zero condition in this word reveals that a fault exists on the module. You can examine further down to isolate the fault.

The table lists tags that can be examined in ladder logic to indicate when a fault has occurred.

Tag	Description
Analog Group Fault	This bit is set when any bits in the Channel Fault word are set. Its tag name is AnalogGroupFault.
Calibrating	This bit is set when any channel is being calibrated. When this bit is set, all bits in the Channel Fault word are set. Its tag name is Calibrating.
Calibration Fault	This bit is set when any of the individual Channel Calibration Fault bits are set. Its tag name is CalibrationFault.

1756-IF16 Channel Fault Word Bits – Floating Point Mode

During normal module operation, bits in the Channel Fault word are set if any of the respective channels has an Under or Overrange condition. Checking this word for a non-zero value is a quick way to check for Under or Overrange conditions on the module.

The table lists the conditions that set all Channel Fault word bits.

This condition sets all Channel Fault word bits	And causes the module to display the following in the Channel Fault word bits
A channel is being calibrated	• 'FFFF' for single-ended operating mode • '00FF' for differential operating mode • '000F' for high-speed differential operating mode
A communication fault occurred between the module and its owner-controller	'FFFF' for all bits, regardless of the application

Your logic can monitor the Channel Fault Word bit for a particular input to determine the state of that point.

1756-IF16 Channel Status Word Bits – Floating Point Mode

Any of the Channel Status words, one for each channel, display a non-zero condition if that particular channel has faulted for the conditions listed below. Some of these bits set bits in other Fault words. When the Underrange or Overrange bits (bits 6 and 5) in any of the words are set, the appropriate bit is set in the Channel Fault word.

When the Calibration Fault bit (bit 7) is set in any of the words, the Calibration Fault bit (bit 9) is set in the Module Fault word. The table lists the conditions that set each of the word bits.

Tag (Status word)	Bit	Event that sets this tag
ChxCalFault	7	This bit is set if an error occurs during calibration for that channel, causing a bad calibration. This bit also sets bit 9 in the Module Fault word.
Underrange	6	This bit is set when the input signal at the channel is less than or equal to the minimum detectable signal. For more information on the minimum detectable signal for each module, see page 61. This bit also sets the appropriate bit in the Channel Fault word.
Overrange	5	This bit is set when the input signal at the channel is greater than or equal to the maximum detectable signal. For more information on the maximum detectable signal for each module, see on page 61. This bit also sets the appropriate bit in the Channel Fault word.
ChxRateAlarm	4[1]	This bit is set when the input channel's rate of change exceeds the configured Rate Alarm parameter. It remains set until the rate of change drops below the configured rate. If latched, the alarm will remain set until it is unlatched.
ChxLAlarm	3[1]	This bit is set when the input signal moves beneath the configured Low Alarm limit. It remains set until the signal moves above the configured trigger point. If latched, the alarm will remain set until it is unlatched. If a deadband is specified, the alarm will also remain set as long as the signal remains within the configured deadband.
ChxHAlarm	2[1]	This bit is set when the input signal moves above the configured High Alarm limit. It remains set until the signal moves below the configured trigger point. If latched, the alarm will remain set until it is unlatched. If a deadband is specified, the alarm will also remain set as long as the signal remains within the configured deadband.
ChxLLAlarm	1[1]	This bit is set when the input signal moves beneath the configured Low-Low Alarm limit. It remains set until the signal moves above the configured trigger point. If latched, the alarm will remain set until it is unlatched. If a deadband is specified, the alarm will also remain latched as long as the signal remains within the configured deadband.
ChxHHAlarm	0[1]	This bit is set when the input signal moves above the configured High-High Alarm limit. It remains set until the signal moves below the configured trigger point. If latched, the alarm will remain set until it is unlatched. If a deadband is specified, the alarm will also remain latched as long as the signal remains within the configured deadband.

(1) Bits 0…4 are **not available** in floating point, single-ended mode.

1756-IF16 Fault Reporting in Integer Mode

The illustration is an example of the fault reporting process for the 1756-IF16 module in integer mode.

Module Fault Word
(described on page 83)

15 = AnalogGroupFault
10 = Calibrating
9 = Cal Fault
14, 13, 12, & 11 are not used

Channel Fault Word
(described on page 83)

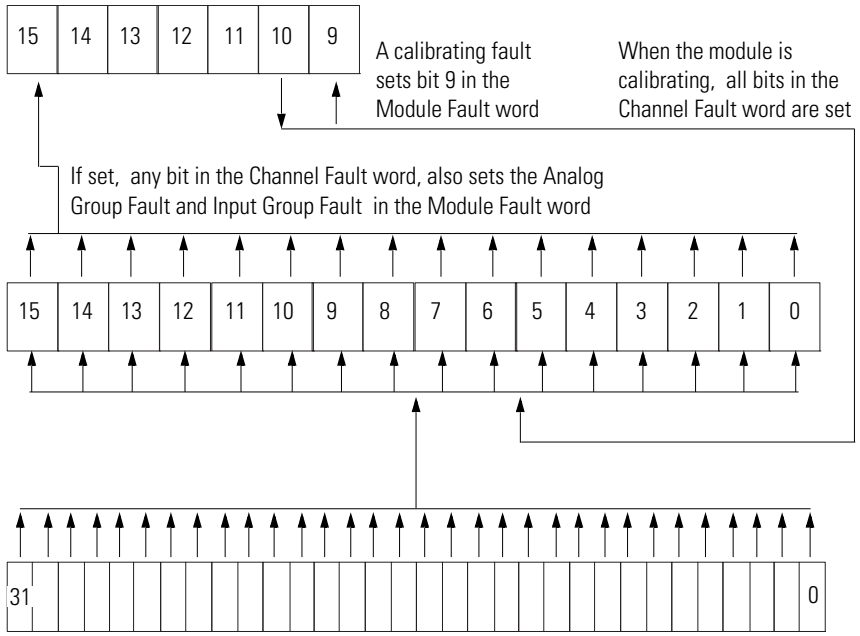
15 = Ch15Fault	7 = Ch7Fault
14 = Ch14Fault	6 = Ch6Fault
13 = Ch13Fault	5 = Ch5Fault
12 = Ch12Fault	4 = Ch4Fault
11 = Ch11Fault	3 = Ch3Fault
10 = Ch10Fault	2 = Ch2Fault
9 = Ch9Fault	1 = Ch1Fault
8 = Ch8Fault	0 = Ch0Fault

16 channels used in S.E. wiring
8 channels used in Diff. wiring
4 channels used in H.S. Diff. wiring
All start at bit 0

Channel Status Words
(described on page 84)

31 = Ch0Underrange	23 = Ch4Underrange	15 = Ch8Underrange	7 = Ch12Underrange
30 = Ch0Overrange	22 = Ch4Overrange	14 = Ch8Overrange	6 = Ch12Overrange
29 = Ch1Underrange	21 = Ch5Underrange	13 = Ch9Underrange	5 = Ch13Underrange
28 = Ch1Overrange	20 = Ch5Overrange	12 = Ch9Overrange	4 = Ch13Overrange
27 = Ch2Underrange	19 = Ch6Underrange	11 = Ch10Underrange	3 = Ch14Underrange
26 = Ch2Overrange	18 = Ch6Overrange	10 = Ch10verrange	2 = Ch14Overrange
25 = Ch3Underrange	17 = Ch7Underrange	9 = C11Underrange	1 = Ch15Underrange
24 = Ch3Overrange	16 = Ch7Overrange	8 = Ch11Overrange	0 = Ch15Overrange

16 channels used in S.E. wiring
Eight channels used in Diff. wiring
Four channels used in H.S. Diff. wiring
All start at bit 31


15 14 13 12 11 10 9
A calibrating fault sets bit 9 in the Module Fault word
When the module is calibrating, all bits in the Channel Fault word are set
If set, any bit in the Channel Fault word, also sets the Analog Group Fault and Input Group Fault in the Module Fault word
15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
31
0
Underrange and overrange conditions set the corresponding Channel Fault word bit for that channel
41513

1756-IF16 Module Fault Word Bits – Integer Mode

In integer mode, Module Fault word bits (bits 15…8) operate exactly as described in floating point mode. The table lists tags that can be examined in ladder logic to indicate when a fault has occurred:

Tag	Description
Analog Group Fault	This bit is set when any bits in the Channel Fault word are set. Its tag name is AnalogGroupFault.
Calibrating	This bit is set when any channel is being calibrated. When this bit is set, all bits in the Channel Fault word are set. Its tag name is Calibrating.
Calibration Fault	This bit is set when any of the individual Channel Calibration Fault bits are set. Its tag name is CalibrationFault.

1756-IF16 Channel Fault Word Bits – Integer Mode

In integer mode, Channel Fault word bits operate exactly as described in floating point mode. The table lists the conditions that set **all** Channel Fault word bits:

This condition sets all Channel Fault word bits	And causes the module to display the following in the Channel Fault word bits
A channel is being calibrated	• 'FFFF' for single-ended operating mode • '00FF' for differential operating mode • '000F' for high-speed differential operating mode
A communications fault occurred between the module and its owner-controller	'FFFF' for all bits, regardless of the application

Your logic can monitor the Channel Fault Word bit for a particular input to determine the state of that point.

1756-IF16 Channel Status Word Bits – Integer Mode

The Channel Status word has these differences when the 1756-IF16 module is used in integer mode.

- Only Underrange and Overrange conditions are reported by the module.
- Alarming and Calibration Fault activities are not available, although the Calibration Fault bit in the Module Fault word activates if a channel is not properly calibrated.
- There is one, 32-bit Channel Status word for all 16 channels.

When the Calibration Fault bit (bit 7) is set in any of the words, the Calibration Fault bit (bit 9) is set in the Module Fault word. The table lists the conditions that set each of the words.

Tag (Status word)	Bit	Event that sets this tag
ChxUnderrange	Odd-numbered bits from 31…1 (bit 31 represents channel 0). For a full listing of the channels these bits represent, see page 82.	The underrange bit is set when the input signal at the channel is less than or equal to the minimum detectable signal. For more information on the minimum detectable signal for each module, see page 61. This bit also sets the appropriate bit in the Channel Fault word.
ChxOverrange	Even-numbered bits from 30 …0 (bit 30 represents channel 0). For a full listing of the channels these bits represent, see on page 82.	The overrange bit is set when the input signal at the channel is greater than or equal to the maximum detectable signal. For more information on the maximum detectable signal for each module, see page 61. This bit also sets the appropriate bit in the Channel Fault word.

1756-IF8 Module Fault and Status Reporting

The 1756-IF8 module multicasts status and fault data to the owner/listening controller with its channel data. The fault data is arranged in such a manner as to let you choose the level of granularity for examining fault conditions.

Three levels of tags work together to provide an increasing degree of detail as to the specific cause of faults on the module.

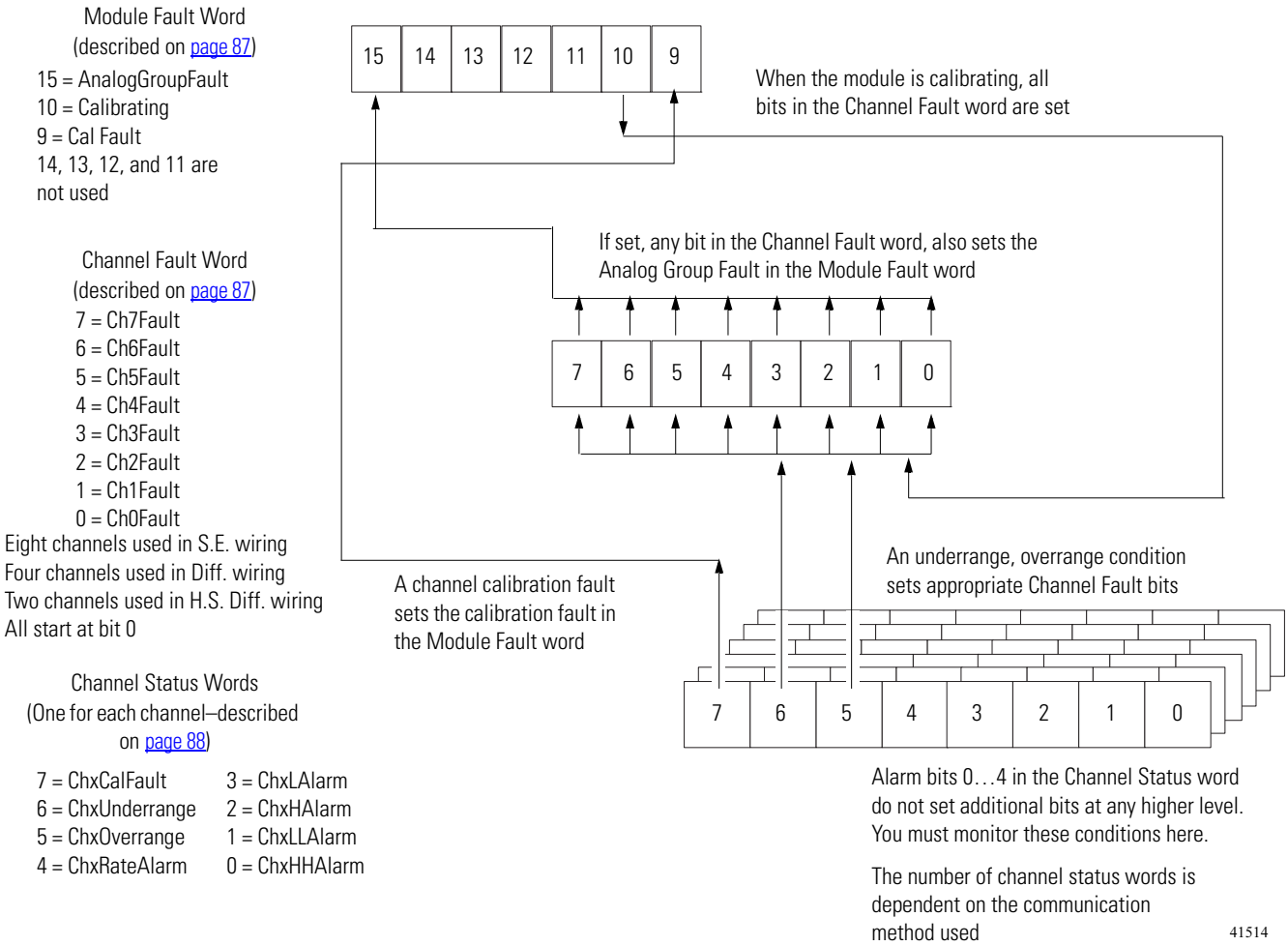
The table lists tags that can be examined in ladder logic to indicate when a fault has occurred:

Tag	Description
Module Fault Word	This word provides fault summary reporting. Its tag name is ModuleFaults.
Channel Fault Word	This word provides underrange, overrange and communication fault reporting. Its tag name is ChannelFaults. When examining the Channel Fault Word for faults, remember the following: • Eight channels are used in single-ended wiring. • Four channels are used in differential wiring. • Two channels are used in high-speed differential wiring. • All bytes start with bit 0.
Channel Status Words	These words, one per channel, provide individual channel underrange and overrange fault reporting for process alarms, rate alarms, and calibration faults. Its tag name is ChxStatus.

IMPORTANT Differences exist between floating point and integer modes as they relate to module fault reporting. These differences are explained in the following two sections.

1756-IF8 Fault Reporting in Floating Point Mode

The illustration describes the fault reporting process for the 1756-IF8 module in floating point mode.


Module Fault Word
(described on page 87)
15 = AnalogGroupFault
10 = Calibrating
9 = Cal Fault
14, 13, 12, and 11 are not used
15 14 13 12 11 10 9
When the module is calibrating, all bits in the Channel Fault word are set
If set, any bit in the Channel Fault word, also sets the Analog Group Fault in the Module Fault word
Channel Fault Word
(described on page 87)
7 = Ch7Fault
6 = Ch6Fault
5 = Ch5Fault
4 = Ch4Fault
3 = Ch3Fault
2 = Ch2Fault
1 = Ch1Fault
0 = Ch0Fault
7 6 5 4 3 2 1 0
Eight channels used in S.E. wiring
Four channels used in Diff. wiring
Two channels used in H.S. Diff. wiring
All start at bit 0
A channel calibration fault sets the calibration fault in the Module Fault word
An underrange, overrange condition sets appropriate Channel Fault bits
7 6 5 4 3 2 1 0
Channel Status Words
(One for each channel–described on page 88)
7 = ChxCalFault
6 = ChxUnderrange
5 = ChxOverrange
4 = ChxRateAlarm
3 = ChxLAlarm
2 = ChxHAlarm
1 = ChxLLAlarm
0 = ChxHHAlarm
Alarm bits 0…4 in the Channel Status word do not set additional bits at any higher level. You must monitor these conditions here.
The number of channel status words is dependent on the communication method used
41514

1756-IF8 Module Fault Word Bits – Floating Point Mode

Bits in this word provide the highest level of fault detection. A non-zero condition in this word reveals that a fault exists on the module. You can examine further down to isolate the fault.

The table lists tags that can be examined in ladder logic to indicate when a fault has occurred:

Tag	Description
Analog Group Fault	This bit is set when any bits in the Channel Fault word are set. Its tag name is AnalogGroupFault.
Calibrating	This bit is set when any channel is being calibrated. When this bit is set, all bits in the Channel Fault word are set. Its tag name is Calibrating.
Calibration Fault	This bit is set when any of the individual Channel Calibration Fault bits are set. Its tag name is CalibrationFault.

1756-IF8 Channel Fault Word Bits – Floating Point Mode

During normal module operation, bits in the Channel Fault word are set if any of the respective channels has an Under or Overrange condition. Checking this word for a non-zero value is a quick way to check for Under or Overrange conditions on the module.

The table lists the conditions that set **all** Channel Fault word bits:

This condition sets all Channel Fault word bits	And causes the module to display the following in the Channel Fault word bits
A channel is being calibrated	• '00FF' for single-ended wiring applications • '000F' for differential wiring applications • '0003' for high speed differential wiring applications
A communication fault occurred between the module and its owner-controller	'FFFF' for all bits, regardless of the application

Your logic can monitor the Channel Fault Word bit for a particular input to determine the state of that point.

1756-IF8 Channel Status Word Bits – Floating Point Mode

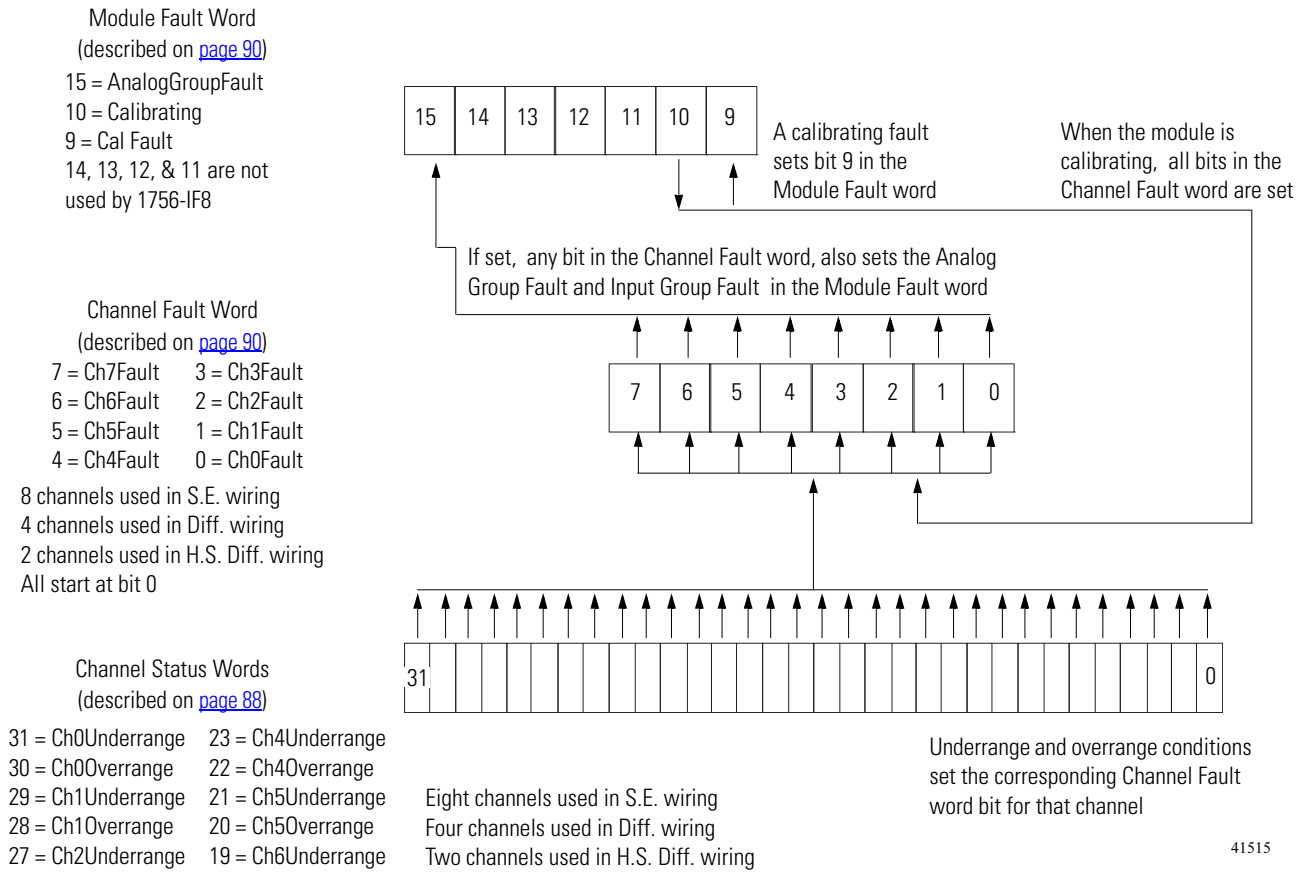
Any of the Channel Status words, one for each channel, will display a non-zero condition if that particular channel has faulted for the conditions listed below. Some of these bits set bits in other Fault words. When the Underrange and Overrange bits (bits 6…5) in any of the words are set, the appropriate bit is set in the Channel Fault word.

When the Calibration Fault bit (bit 7) is set in any of the words, the Calibration Fault bit (bit 9) is set in the Module Fault word. The table lists the conditions that set each of the word bits.

Tag (Status word)	Bit	Event that sets this tag
ChxCalFault	7	This bit is set if an error occurs during calibration for that channel, causing a bad calibration. This bit also sets bit 9 in the Module Fault word.
Underrange	6	This bit is set when the input signal at the channel is less than or equal to the minimum detectable signal. For more information on the minimum detectable signal for each module, see page 61. This bit also sets the appropriate bit in the Channel Fault word.
Overrange	5	This bit is set when the input signal at the channel is greater than or equal to the maximum detectable signal. For more information on the maximum detectable signal for each module, see page 61. This bit also sets the appropriate bit in the Channel Fault word.
ChxRateAlarm	4	This bit is set when the input channel's rate of change exceeds the configured Rate Alarm parameter. It remains set until the rate of change drops below the configured rate. If latched, the alarm will remain set until it is unlatched.
ChxLAlarm	3	This bit is set when the input signal moves beneath the configured Low Alarm limit. It remains set until the signal moves above the configured trigger point. If latched, the alarm will remain set until it is unlatched. If a deadband is specified, the alarm will also remain set as long as the signal remains within the configured deadband.
ChxHAlarm	2	This bit is set when the input signal moves above the configured High Alarm limit. It remains set until the signal moves below the configured trigger point. If latched, the alarm will remain set until it is unlatched. If a deadband is specified, the alarm will also remain set as long as the signal remains within the configured deadband.
ChxLLAlarm	1	This bit is set when the input signal moves beneath the configured Low-Low Alarm limit. It remains set until the signal moves above the configured trigger point. If latched, the alarm will remain set until it is unlatched. If a deadband is specified, the alarm will also remain latched as long as the signal remains within the configured deadband.
ChxHHAlarm	0	This bit is set when the input signal moves above the configured High-High Alarm limit. It remains set until the signal moves below the configured trigger point. If latched, the alarm will remain set until it is unlatched. If a deadband is specified, the alarm will also remain latched as long as the signal remains within the configured deadband.

1756-IF8 Fault Reporting in Integer Mode

The illustration is an example of the fault reporting process for the 1756-IF8 module in integer mode.


Module Fault Word
(described on page 90)
15 = AnalogGroupFault
10 = Calibrating
9 = Cal Fault
14, 13, 12, & 11 are not used by 1756-IF8
15 14 13 12 11 10 9
A calibrating fault sets bit 9 in the Module Fault word
When the module is calibrating, all bits in the Channel Fault word are set
If set, any bit in the Channel Fault word, also sets the Analog Group Fault and Input Group Fault in the Module Fault word
Channel Fault Word
(described on page 90)
7 = Ch7Fault
6 = Ch6Fault
5 = Ch5Fault
4 = Ch4Fault
3 = Ch3Fault
2 = Ch2Fault
1 = Ch1Fault
0 = Ch0Fault
8 channels used in S.E. wiring
4 channels used in Diff. wiring
2 channels used in H.S. Diff. wiring
All start at bit 0
7 6 5 4 3 2 1 0
Channel Status Words
(described on page 88)
31 = Ch0Underrange
30 = Ch0Overrange
29 = Ch1Underrange
28 = Ch1Overrange
27 = Ch2Underrange
26 = Ch2Overrange
25 = Ch3Underrange
24 = Ch3Overrange
23 = Ch4Underrange
22 = Ch4Overrange
21 = Ch5Underrange
20 = Ch5Overrange
19 = Ch6Underrange
18 = Ch6Overrange
17 = Ch7Underrange
16 = Ch7Overrange
31 0
Eight channels used in S.E. wiring
Four channels used in Diff. wiring
Two channels used in H.S. Diff. wiring
All start at bit 31
Underrange and overrange conditions set the corresponding Channel Fault word bit for that channel
41515

1756-IF8 Module Fault Word Bits – Integer Mode

In integer mode, Module Fault word bits (bits 15…8) operate exactly as described in floating point mode. The table lists tags that can be examined in ladder logic to indicate when a fault has occurred:

Tag	Description
Analog Group Fault	This bit is set when any bits in the Channel Fault word are set. Its tag name is AnalogGroupFault.
Calibrating	This bit is set when any channel is being calibrated. When this bit is set, all bits in the Channel Fault word are set. Its tag name is Calibrating.
Calibration Fault	This bit is set when any of the individual Channel Calibration Fault bits are set. Its tag name is CalibrationFault.

1756-IF8 Channel Fault Word Bits – Integer Mode

In integer mode, Channel Fault word bits operate exactly as described in floating point mode. The table lists the conditions that set **all** Channel Fault word bits:

This condition sets all Channel Fault word bits	And causes the module to display the following in the Channel Fault word bits
A channel is being calibrated	• '00FF' for single-ended wiring applications • '000F' for differential wiring applications • '0003' for high-speed differential wiring applications
A communications fault occurred between the module and its owner-controller	'FFFF' for all bits, regardless of the application

1756-IF8 Channel Status Word Bits – Integer Mode

The Channel Status word has the following differences when the 1756-IF16 module is used in integer mode:

- Only Underrange and Overrange conditions are reported by the module.
- Alarming and Calibration Fault activities are not available, although the Calibration Fault bit in the Module Fault word activates if a channel is not properly calibrated.
- There is one, 32-bit Channel Status word for all eight channels.

When the Calibration Fault bit (bit 7) is set in any of the words, the Calibration Fault bit (bit 9) is set in the Module Fault word. The table lists the conditions that set each of the words.

Tag (Status word)	Bit	Event that sets this tag
ChxUnderrange	Odd-numbered bits from 31…1 (bit 31 represents channel 17). For a full listing of the channels these bits represent, see on page 88.	The underrange bit is set when the input signal at the channel is less than or equal to the minimum detectable signal. For more information on the minimum detectable signal for each module, see page 61. This bit also sets the appropriate bit in the Channel Fault word.
ChxOverrange	Even-numbered bits from 30…16 (bit 30 represents channel 0). For a full listing of the channels these bits represent, see on page 91.	The overrange bit is set when the input signal at the channel is greater than or equal to the maximum detectable signal. For more information on the maximum detectable signal for each module, see page 61. This bit also sets the appropriate bit in the Channel Fault word.

Notes:

Sourcing Current Loop Input Module (1756-IF6CIS) and Isolated Analog Voltage/Current Input Module (1756-IF6I)

Introduction

This chapter describes features specific to the ControlLogix isolated analog voltage/current input module and the ControlLogix sourcing current loop input module..

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Choose a Data Format	95
Features Specific to the 1756-IF6I and 1756-IF6CIS Modules	96
Use Module Block and Input Circuit Diagrams	104
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IMPORTANT

The 1756-IF6CIS and 1756-IF6I modules primarily operate the same with a few exceptions, including:

- The 1756-IF6CIS only operates in current mode.
- The 1756-IF6CIS offers an isolated power source for each channel that supplies power to external transmitters.

The differences on the 1756-IF6CIS module are described on page 94.

With a few noted exceptions included in the descriptions, the rest of the features described in this chapter apply to both modules.

Use the Isolated Power Source on the 1756-IF6CIS

The 1756-IF6CIS module offers an internal power source on each channel. The source is current limited to 28 mA and allows the module to power a two-wire transmitter directly without the need for an external power supply. The transmitter can then vary the current to the analog input in proportion to the process variable being measured. The inclusion of an internal on-board current source saves you the expense of extra power supplies and greatly simplifies the interface wiring to field devices.

In addition to supplying loop power to two-wire transmitters, the module can also accommodate current loops powered by an external supply and loops using four-wire transmitters.

Power Calculations with the 1756-IF6CIS Module

The 1756-IF6CIS module uses the system power supply (1756-Px7x) as the source for loop power. Because of the demands placed on that supply (that is, the 1756-IF6CIS module consumes 7.9 W of backplane power), special care must be taken when calculating the power requirements for modules in the same chassis as a 1756-IF6CIS module.

For example, when used with the 1756-L55M13 controller, you can place only eight 1756-IF6CIS modules in the chassis before exceeding the wattage capacity of the power supply.

Other Devices in the Wiring Loop

The voltage source on each channel can drive loop impedance of up to 1000 ohms. This lets you include other devices, such as chart recorders and meters, in the current loop.

For more information on wiring the 1756-IF6CIS module, see page 106.

The 1756-IF6CIS and 1756-IF6I modules also support features described in Chapter 3. See the table for some of these features.

Feature	Page
Removal and Insertion Under Power (RIUP)	36
Module Fault Reporting	36
Configurable Software	36
Electronic Keying	37
Access to System Clock for Timestamp Functions	44
Rolling Timestamp	44
Producer/Consumer Model	44
Status Indicator Information	45
Full Class I Division 2 Compliance	45
Agency Certification	45
Sensor Offset	46
Latching of Alarms	46

Choose a Data Format

Data format determines the format of the data returned from the module to the owner-controller and the features that are available to your application. You choose a data format when you choose a Communication Format.

You can choose one of these data formats:

- Integer mode
- Floating point mode

The table shows features that are available in each format.

Data Format	Features Available	Features Not Available
Integer mode	Multiple input ranges Notch filter Real time sampling	Digital filtering Process alarms Rate alarms Scaling
Floating point mode	All features	N/A

For details on input and output data formats, see page 205 in Chapter 10.

Features Specific to the 1756-IF6I and 1756-IF6CIS Modules

The table lists features that are specific to the 1756-IF6CIS and 1756-IF6I modules. Each feature is described later in this section.

Feature	Page
Multiple Input Ranges[1]	96
Notch Filter	97
Real Time Sampling	98
Underrange/Overrange Detection	98
Digital Filter	99
Process Alarms	100
Rate Alarm	101
Wire Off Detection	102

(1) Only the 1756-IF6I offers multiple input ranges. The 1756-IF6CIS module only operates in the 0…20 mA range.

Multiple Input Ranges

You can only use the 1756-IF6CIS module in current applications. Unlike other analog input modules, this module does not let you choose an input range. All channels use the 0…20 mA input range.

For the 1756-IF6I module, however, you can select from a series of operational ranges for **each channel** on your module. The range designates the minimum and maximum signals that are detectable by the module. The 1756-IF6I module offers multiple input ranges in both current and voltage applications.

The table lists the possible input ranges available for use with the 1756-IF6CIS and 1756-IF6I modules.

Module	Input Ranges
1756-IF6CIS	0…20 mA
1756-IF6I	-10…10V 0…5V 0…10V 0…20 mA

For an example of how to choose an input range for your module, see page 210.

Notch Filter

An analog-to-digital convertor (ADC) filter removes line noise in your application for **each channel**.

Choose a notch filter that most closely matches the anticipated noise frequency in your application. Remember that each filter time affects the response time of your module. Also, the highest frequency notch filter settings also limit the effective resolution of the channel.

IMPORTANT 60 Hz is the default setting for the notch filter.

The table lists the available notch filter setting.

Notch Setting	10 Hz	50 Hz	60 Hz (Default)	100 Hz	250 Hz	1000 Hz
Minimum Sample Time (RTS) – Integer mode[1]	102 ms	22 ms	19 ms	12 ms	10 ms	10 ms
Minimum Sample Time (RTS) – Floating point mode[2]	102 ms	25 ms	25 ms	25 ms	25 ms	25 ms
0…100% Step Response Time[2]	400 ms + RTS	80 ms + RTS	68 ms + RTS	40 ms + RTS	16 ms + RTS	4 ms + RTS
-3dB Frequency	3 Hz	13 Hz	15 Hz	26 Hz	66 Hz	262 Hz
Effective Resolution	16 bits	16 bits	16 bits	16 bits	15 bits	10 bits

(1) Integer mode must be used for RTS values lower than 25 ms. The minimum RTS value for the module will be dependent on the channel with the lowest notch filter setting.

(2) Worst case setting time to 100% of a step change would include 0…100% step response time plus one RTS sample time.

To see how to choose a notch filter, see page 210.

Real Time Sampling

This parameter instructs the module to scan its input channels and obtain all available data. After the channels are scanned, the module multicasts that data.

During module configuration, you specify a real time sampling (RTS) period and a requested packet interval (RPI) period. These features both instruct the module to multicast data, but only the RTS feature instructs the module to scan its channels before multicasting.

For more information on real time sampling, see page 24. For an example of how to set the RTS rate, see page 210.

Underrange/Overrange Detection

This alarm feature detects when the isolated input module is operating beyond limits set by the input range. For example, if you are using the 1756-IF6I module in the 0…10V input range and the module voltage increases to 11V, the overrange detects this condition.

The table lists the input ranges of the 1756-IF6CIS and 1756-IF6I modules and the lowest/highest signal available in each range before the module detects an underrange/overrange condition.

Input Module	Range	Lowest Signal in Range	Highest Signal in Range
1756-IF6CIS	0 mA…20 mA	0 mA	21.09376 mA
1756-IF6I	+/- 10V	-10.54688V	10.54688V
	0V…10V	0V	10.54688V
	0V…5V	0V	5.27344V
	0 mA…20 mA	0 mA	21.09376 mA

IMPORTANT Be careful when 'disabling all alarms' on the channel because it also disables the underrange/overrange detection feature. If alarms are disabled, overrange/underrange is zero and the only way you can discover a wire-off detection is from the input value itself. If you need to detect a wire-off status, do not 'disable all alarms'.

We recommend that you disable only unused channels so extraneous alarm bits are not set.

Digital Filter

The digital filter smooths input data noise transients on **each input channel**. This value specifies the time constant for a digital, first-order lag filter on the input. It is specified in units of milliseconds. A value of 0 (zero) disables the filter.

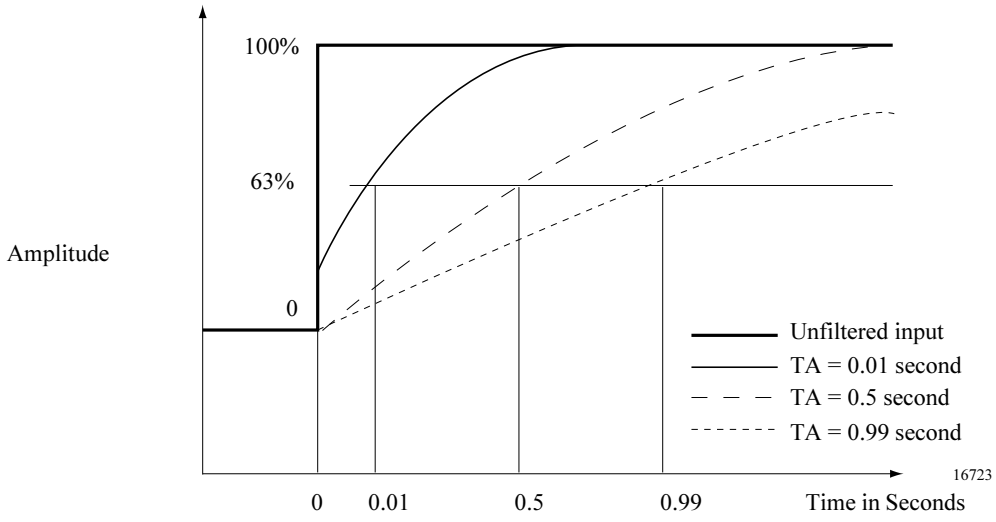
IMPORTANT The digital filter is available only in applications that use floating point mode.

The digital filter equation is a classic, first order lag equation.

$$Yn = Yn\text{-}1 + \frac{[\Delta t]}{\Delta t + TA} (X_n - Y_n\text{-}1)$$

Yn = Present output, filtered peak voltage (PV)
Yn-1 = Previous output, filtered PV
Δt = Module channel update time (seconds)
TA = Digital filter time constant (seconds)
Xn = Present input, unfiltered PV

As shown in the illustration, by using a step input change to illustrate the filter response, you see that 63.2% of the total response is reached when the digital filter time constant elapses. Each additional time constant achieves 63.2% of the remaining response.



To see how to set a digital filter, see page 210.

Process Alarms

Process alarms alert you when the module has exceeded configured high or low limits for **each channel**. You can latch process alarms. These are set at four, user-configurable, alarm trigger points.

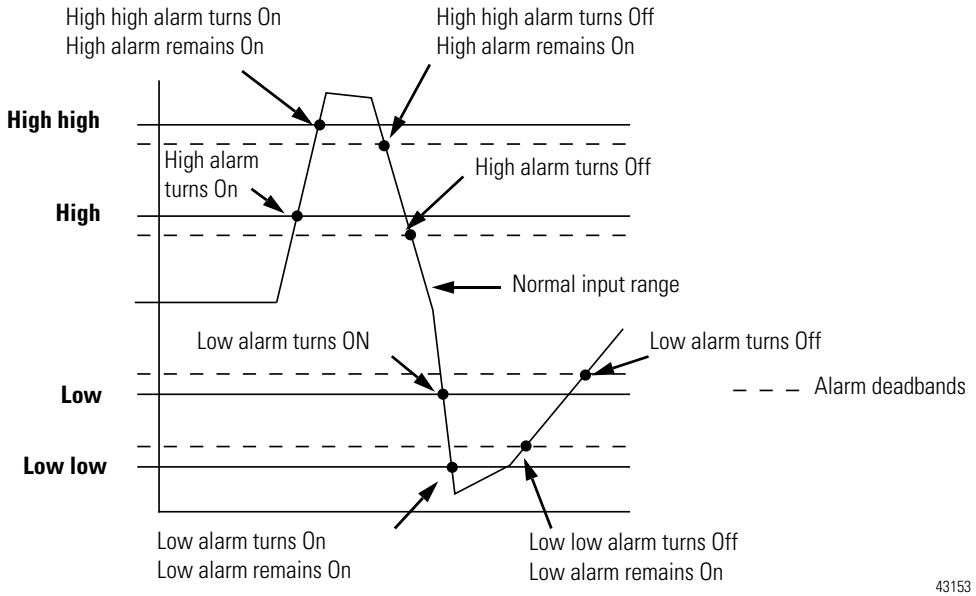
- High high
- High
- Low
- Low low

IMPORTANT Process alarms are available only in applications that use floating point mode. The values for each limit are entered in scaled engineering units.

Alarm Deadband

You may configure an alarm deadband to work with these alarms. The deadband allows the process alarm status bit to remain set, despite the alarm condition disappearing, as long as the input data remains within the deadband of the process alarm.

The illustration shows input data that sets each of the four alarms at some point during module operation. In this example, latching is disabled; therefore, each alarm turns Off when the condition that caused it to set ceases to exist.



To see how to set process alarms, see page 212.

Rate Alarm

The rate alarm triggers if the rate of change between input samples for **each channel** exceeds the specified trigger point for that channel.

IMPORTANT The rate alarm is available only for applications that use floating point mode.

EXAMPLE

1756-IF6CIS

If you set an 1756-IF6I (with normal scaling in mA) to a rate alarm of 1.0 mA/s, the rate alarm only triggers if the difference between measured input samples changes at a rate > 1.0 mA/s.

If the module's RTS is 100 ms (that is, sampling new input data every 100 ms) and at time 0, the module measures 5.0 mA and at time 100 ms measures 5.08 mA, the rate of change is (5.08 mA - 5.0 mA) / (100 ms) = 0.8 mA/s. The rate alarm would not set as the change is less than the trigger point of 1.0 mA/s.

If the next sample taken is 4.9 mA, the rate of change is (4.9 mA-5.08V)/(100 ms)=-1.8 mA/s. The absolute value of this result is > 1.0 mA/s, so the rate alarm sets. Absolute value is used because rate alarm checks for the magnitude of the rate of change being beyond the trigger point, whether a positive or negative excursion.

1756-IF6I

If you set an 1756-IF6I (with normal scaling in volts) to a rate alarm of 1.0V/s, the rate alarm only triggers if the difference between measured input samples changes at a rate > 1.0V/s.

If the module's RTS is 100 ms (that is, sampling new input data every 100 ms) and at time 0, the module measures 5.0V and at time 100 ms measures 5.08V, the rate of change is (5.08V - 5.0V) / (100 ms) = 0.8V/s. The rate alarm would not set as the change is less than the trigger point of 1.0V/s.

If the next sample taken is 4.9V, the rate of change is (4.9V-5.08V)/(100 ms)=-1.8V/s. The absolute value of this result is > 1.0V/s, so the rate alarm sets. Absolute value is used because rate alarm checks for the magnitude of the rate of change being beyond the trigger point, whether a positive or negative excursion.

To see how to set the rate alarm, see page 212.

Wire Off Detection

IMPORTANT Be careful when 'disabling all alarms' on the channel because it also disables the underrange/overrange detection feature. If alarms are disabled, overrange/underrange is zero and the only way you can discover a wire-off detection is from the input value itself. If you need to detect a wire-off status, do not 'disable all alarms'.

We recommend that you disable only unused channels so extraneous alarm bits are not set.

The 1756-IF6CIS and 1756-IF6I modules will alert you when a wire has been disconnected from one of its channels or the RTB has been removed from the module. Two events occur when a wire off condition occurs for this module.

- Input data for that channel changes to a specific scaled value.
- A fault bit is set in the owner-controller that may indicate the presence of a wire off condition.

Because the 1756-IF6I module can be used in voltage or current applications, differences exist as to how a wire off condition is detected in each application. The 1756-IF6CIS module can only be used in current mode.

The table lists the differences that occur when a wire off condition occurs in various applications.

Wire Off Conditions in Different Applications

Wire Off Condition	Occurrence
Voltage Applications 1756-IF6I only	• Input data for that channel changes to the scaled value associated with the **overrange** signal value of the selected operational range in floating point mode (maximum possible scaled value) or 32,767 counts in integer mode. • The ChxOverrange (x=channel number) tag is set to 1.

Wire Off Conditions in Different Applications

Wire Off Condition	Occurrence
Current Applications	When the condition occurs because a wire is disconnected: • Input data for that channel changes to the scaled value associated with the **underrange** signal value of the selected operational range in floating point mode (minimum possible scaled value) or -32,768 counts in integer mode. • The ChxUnderrange (x=channel number) tag is set to 1. When the condition occurs because the RTB has been disconnected from the module (1756-IF6I module only): • Input data for that channel changes to the scaled value associated with the **overrange** signal value of the selected operational range in floating point mode (maximum possible scaled value) or 32,767 counts in integer mode. • The ChxOverrange (x=channel number) tag is set to 1.

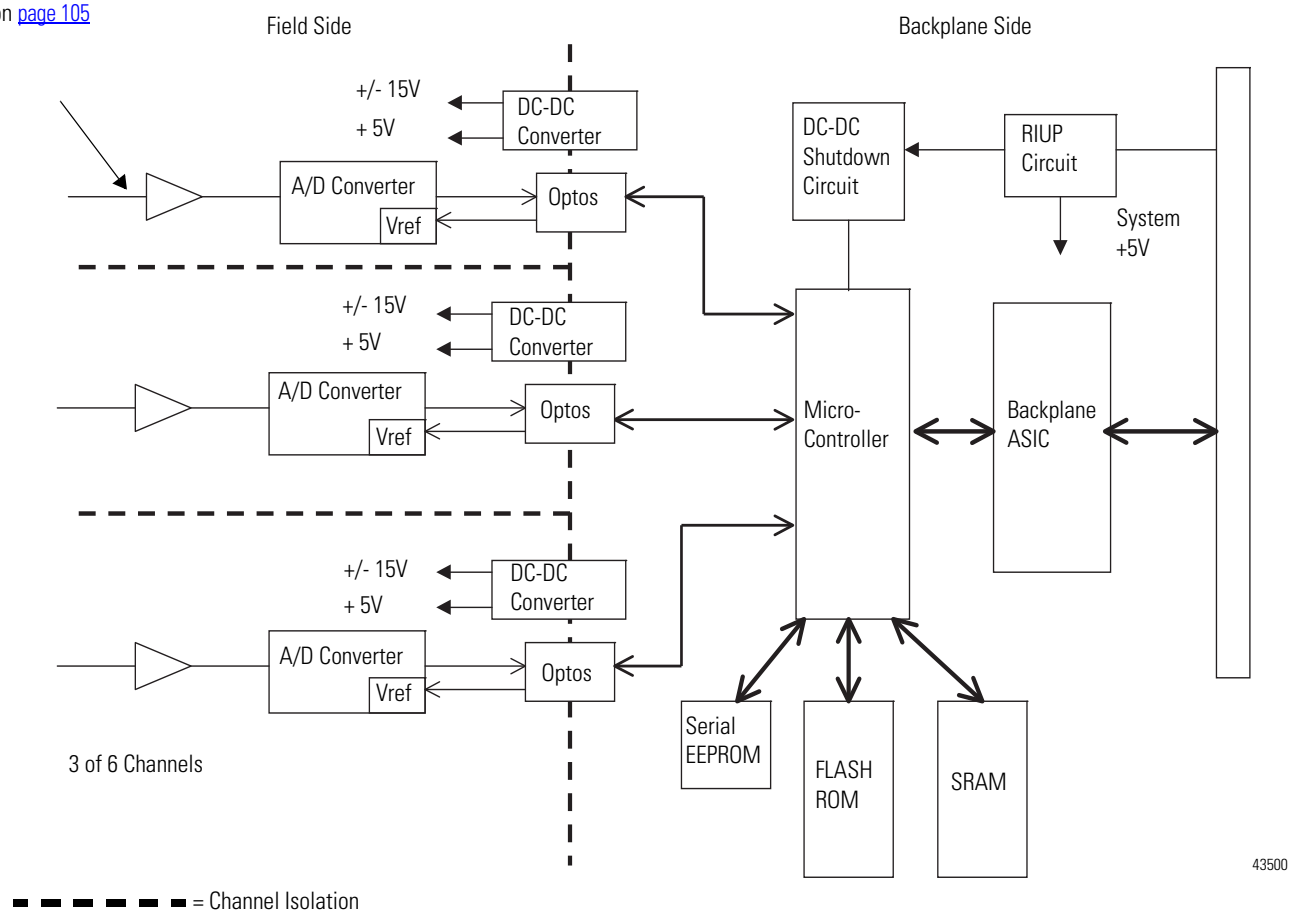
For more tag information, see Appendix B.

Use Module Block and Input Circuit Diagrams

This section shows the 1756-IF6CIS and 1756-IF6I modules' block diagrams and input circuit diagrams.

1756-IF6CIS and 1756-IF6I Module Block Diagram

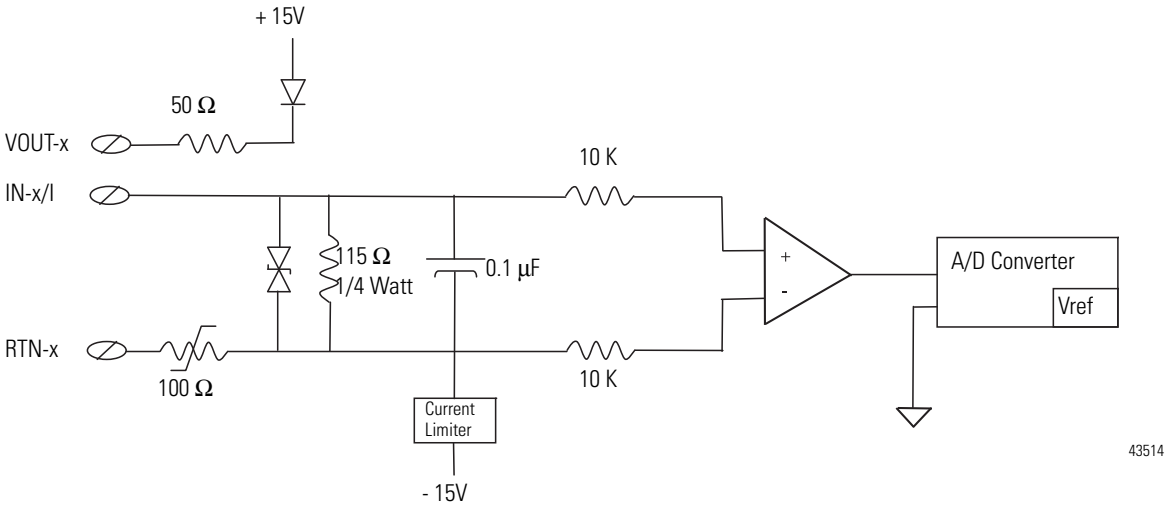
Details of the 1756-IF6CIS and 1756-IF6I modules' input circuitry are given on page 105



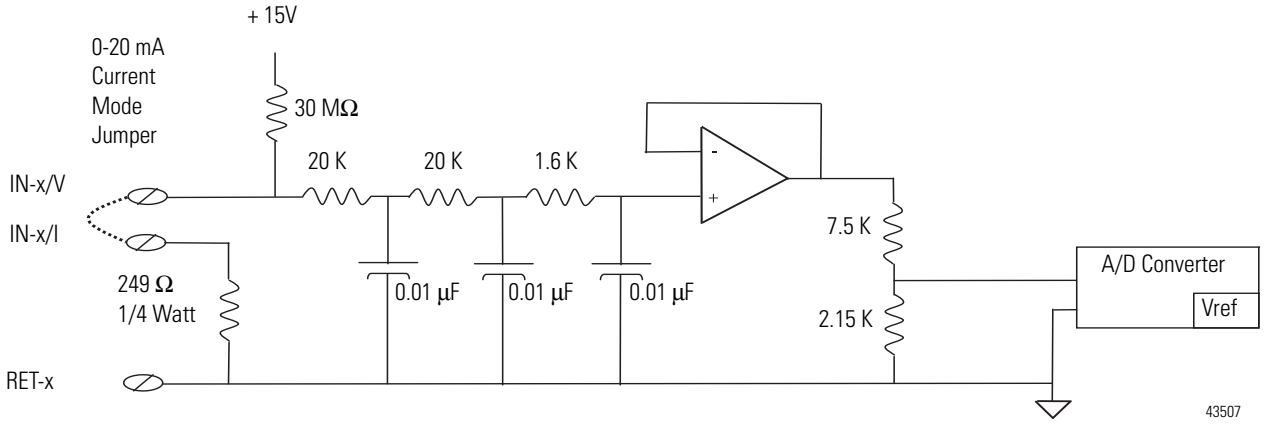
Field-side Circuit Diagrams

The diagrams show field-side circuitry for the 1756-IF6CIS and 1756-IF6I modules.

1756-IF6CIS Input Circuit

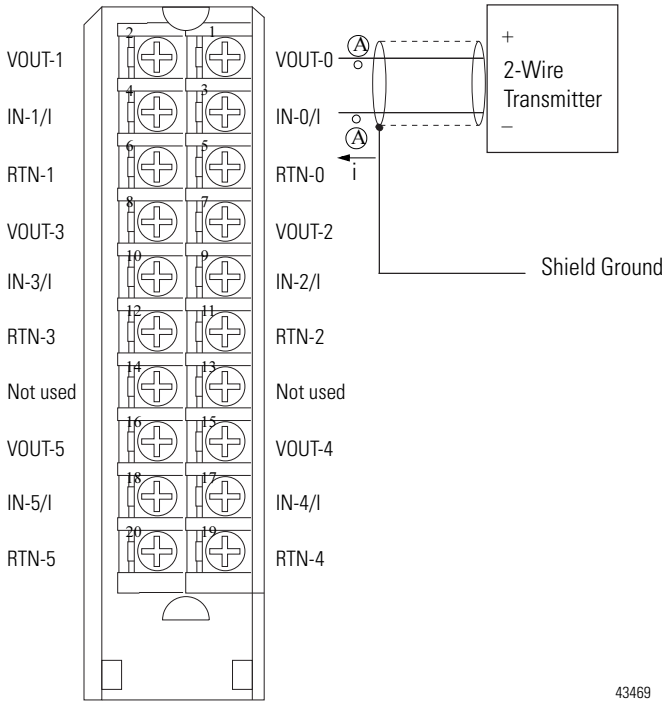


1756-IF6I Input Circuit



Wire the 1756-IF6CIS Module

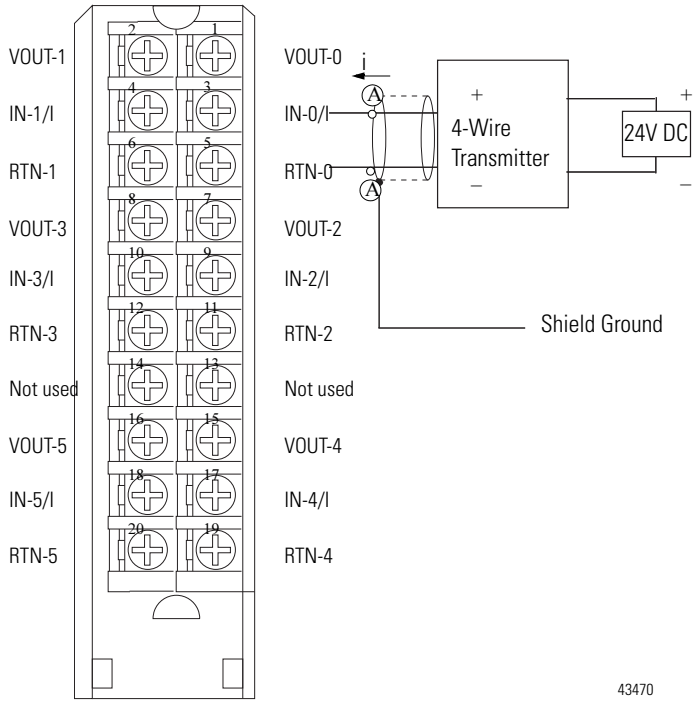
1756-IF6CIS – Two -wire transmitter connected to the module and the module providing 24V DC loop power



NOTES:

1. Do not connect more than two wires to any single terminal.
2. Place additional loop devices (that is, strip chart recorders) at either 'A' location in the current loop.

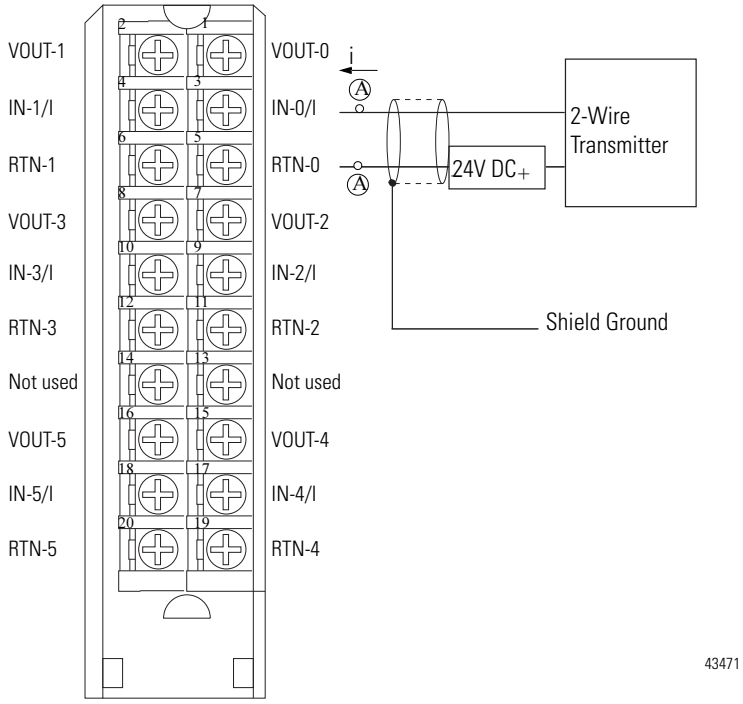
1756-IF6CIS – Four-wire transmitter connected to the module and an external, user-provided power supply providing 24V DC loop power



NOTES:

1. If separate power sources are used, do not exceed the specified isolation voltage.
2. Do not connect more than two wires to any single terminal.
3. Place additional loop devices (that is, strip chart recorders) at either 'A' location in the current loop.

1756-IF6CIS – Two-wire transmitter connected to the module and an external, user-provided power supply providing 24V DC loop power

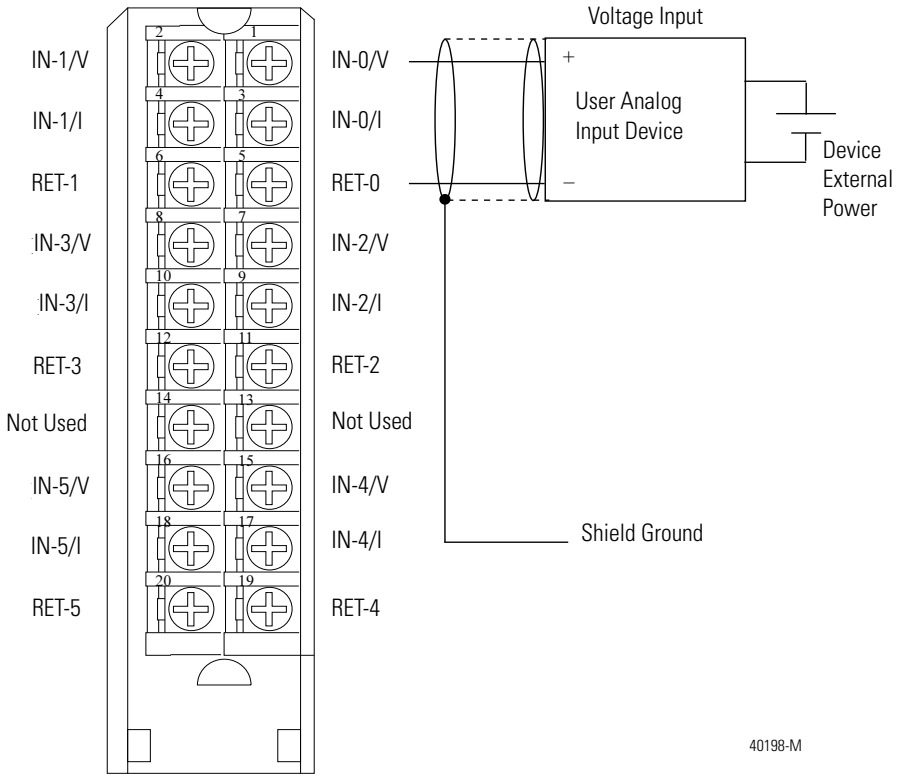


NOTES:

1. If separate power sources are used, do not exceed the specified isolation voltage.
2. Do not connect more than two wires to any single terminal.
3. Place additional loop devices (that is, strip chart recorders) at either 'A' location in the current loop.

Wire the 1756-IF6I Module

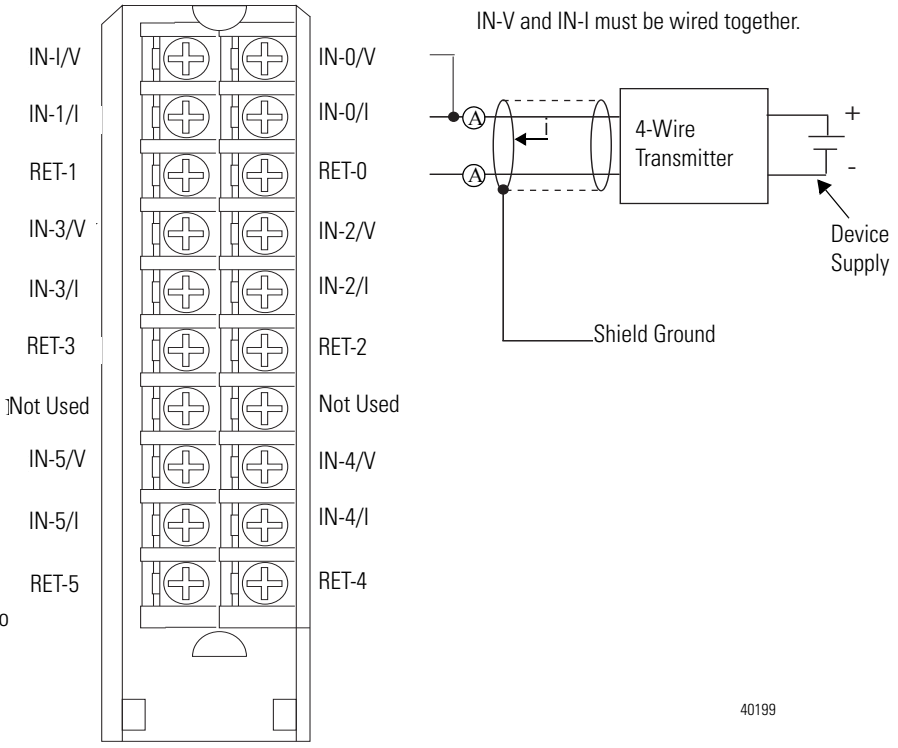
The illustration shows a wiring example for the 1756-IF6I module.



NOTES:

1. Do not connect more than two wires to any single terminal.

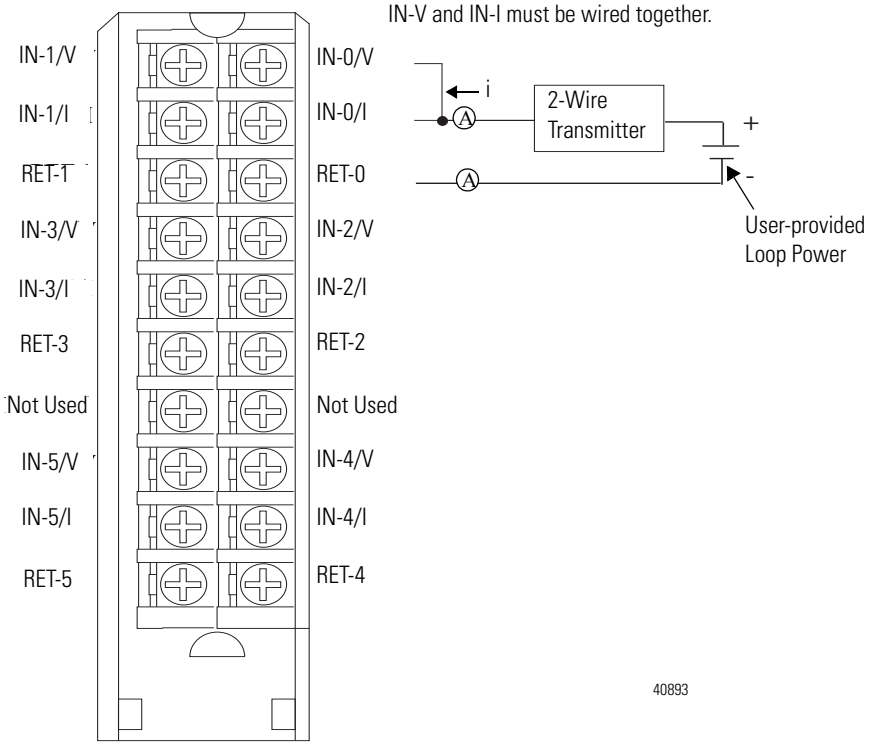
1756-IF6I Current Wiring Example with a Four-Wire Transmitter



NOTES:

1. Do not connect more than two wires to any single terminal.
2. Place additional loop devices (that is, strip recorders) at either 'A' location.

1756-IF6I Current Wiring Example with a Two-Wire Transmitter



NOTES:

1. Do not connect more than two wires to any single terminal.
2. Place additional loop devices (that is, strip recorders) at either 'A' location.

1756-IF6CIS or 1756-IF6I Module Fault and Status Reporting

The 1756-IF6CIS and 1756-IF6I modules multicast status and fault data to the owner/listening controllers with its channel data. The fault data is arranged in such a manner as to let you choose the level of granularity for examining fault conditions.

Three levels of tags work together to provide increasing degree of detail as to the specific cause of faults on the module.

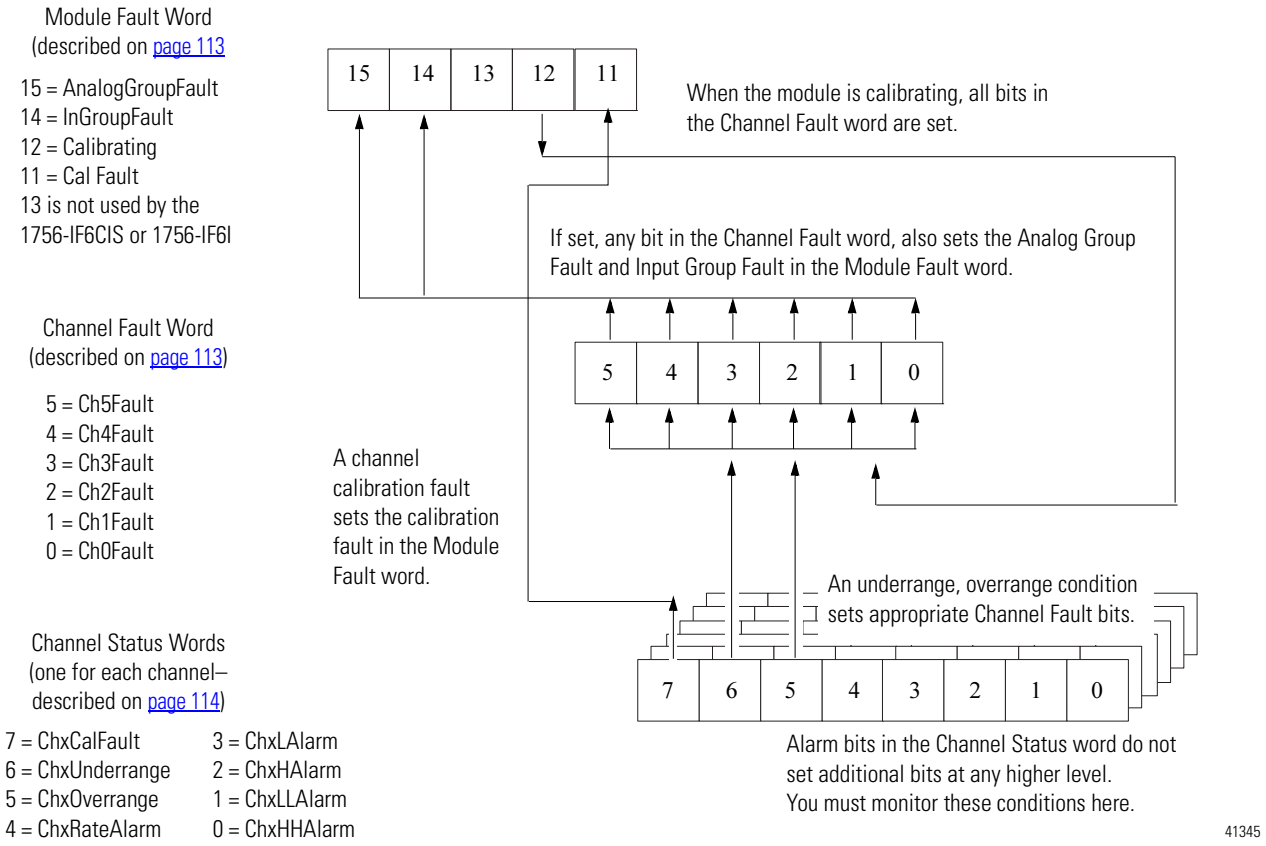
The table lists tags that can be examined in ladder logic to indicate when a fault occurs.

Tag	Description
Module Fault Word	This word provides fault summary reporting. Its tag name is ModuleFaults.
Channel Fault Word	This word provides underrange, overrange and communications fault reporting. Its tag name is ChannelFaults.
Channel Status Words	This word provides individual channel underrange and overrange fault reporting for process alarms, rate alarms, and calibration faults. Its tag name is ChxStatus.

IMPORTANT Differences exist between floating point and integer modes as they relate to module fault reporting. These differences are explained in the following two sections.

Fault Reporting in Floating Point Mode

The illustration provides an overview of the fault reporting process in floating point mode.


Module Fault Word
(described on page 113
15 = AnalogGroupFault
14 = InGroupFault
12 = Calibrating
11 = Cal Fault
13 is not used by the
1756-IF6CIS or 1756-IF6I
15 14 13 12 11
When the module is calibrating, all bits in the Channel Fault word are set.
If set, any bit in the Channel Fault word, also sets the Analog Group Fault and Input Group Fault in the Module Fault word.
Channel Fault Word
(described on page 113)
5 = Ch5Fault
4 = Ch4Fault
3 = Ch3Fault
2 = Ch2Fault
1 = Ch1Fault
0 = Ch0Fault
5 4 3 2 1 0
A channel calibration fault sets the calibration fault in the Module Fault word.
An underrange, overrange condition sets appropriate Channel Fault bits.
Channel Status Words
(one for each channel–
described on page 114)
7 = ChxCalFault
6 = ChxUnderrange
5 = ChxOverrange
4 = ChxRateAlarm
3 = ChxLAlarm
2 = ChxHAlarm
1 = ChxLLAlarm
0 = ChxHHAlarm
7 6 5 4 3 2 1 0
Alarm bits in the Channel Status word do not set additional bits at any higher level.
You must monitor these conditions here.
41345

Module Fault Word Bits – Floating Point Mode

Bits in this word provide the highest level of fault detection. A nonzero condition in this word reveals that a fault exists on the module. You can examine further down to isolate the fault.

The table lists tags that can be examined in ladder logic to indicate when a fault has occurred:

Tag	Description
Analog Group Fault	This bit is set when any bits in the Channel Fault word are set. Its tag name is AnalogGroupFault.
Input Group Fault	This bit is set when any bits in the Channel Fault word are set. Its tag name is InputGroup.
Calibrating	This bit is set when any channel is being calibrated. When this bit is set, all bits in the Channel Fault word are set. Its tag name is Calibrating.
Calibration Fault	This bit is set when any of the individual Channel Calibration Fault bits are set. Its tag name is CalibrationFault.

Channel Fault Word Bits – Floating Point Mode

During normal module operation, bits in the Channel Fault word are set if any of the respective channels has an Under or Overrange condition. Checking this word for a non-zero value is a quick way to check for Under or Overrange conditions on the module.

The table lists the conditions that set all Channel Fault word bits.

Conditions for Channel Fault Word Bits	Displays
A channel is being calibrated.	'003F' for all bits.
A communication fault occurred between the module and its owner-controller.	'FFFF' for all bits.

Your logic can monitor the Channel Fault Word bit for a particular input to determine the state of that point.

Channel Status Word Bits – Floating Point Mode

Any of the six Channel Status words, one for each channel, will display a non-zero condition if that particular channel has faulted for the conditions listed below. Some of these bits set bits in other Fault words. When the Underrange and Overrange bits (bits 6 & 5) in any of the words are set, the appropriate bit is set in the Channel Fault word.

When the Calibration Fault bit (bit 7) is set in any of the words, the Calibration Fault bit (bit 11) is set in the Module Fault word. The table lists the conditions that set each of the word bits.

Tag (Status word)	Bit	Event that sets this tag
ChxCalFault	Bit 7	This bit is set if an error occurs during calibration for that channel, causing a bad calibration. This bit also sets bit 9 in the Module Fault word.
Underrange	Bit 6	This bit is set when the input signal at the channel is less than or equal to the minimum detectable signal. For more information on the minimum detectable signal for each module, see page 98. This bit also sets the appropriate bit in the Channel Fault word.
Overrange	Bit 5	This bit is set when the input signal at the channel is greater than or equal to the maximum detectable signal. For more information on the maximum detectable signal for each module, see page 98. This bit also sets the appropriate bit in the Channel Fault word.
ChxRateAlarm	Bit 4	This bit is set when the input channel's rate of change exceeds the configured Rate Alarm parameter. It remains set until the rate of change drops below the configured rate. If latched, the alarm remains set until it is unlatched.
ChxLAlarm	Blt 3	This bit is set when the input signal moves beneath the configured Low Alarm limit. It remains set until the signal moves above the configured trigger point. If latched, the alarm will remain set until it is unlatched. If a deadband is specified, the alarm will also remain set as long as the signal remains within the configured deadband.
ChxHAlarm	Bit 2	This bit is set when the input signal moves above the configured High Alarm limit. It remains set until the signal moves below the configured trigger point. If latched, the alarm remains set until it is unlatched. If a deadband is specified, the alarm also remains set as long as the signal remains within the configured deadband.
ChxLLAlarm	Bit 1	This bit is set when the input signal moves beneath the configured Low-Low Alarm limit. It remains set until the signal moves above the configured trigger point. If latched, the alarm remains set until it is unlatched. If a deadband is specified, the alarm also remains latched as long as the signal remains within the configured deadband.
ChxHHAlarm	Bit 0	This bit is set when the input signal moves above the configured High-High Alarm limit. It remains set until the signal moves below the configured trigger point. If latched, the alarm remains set until it is unlatched. If a deadband is specified, the alarm also remains latched as long as the signal remains within the configured deadband.

Fault Reporting in Integer Mode

The illustration offers an overview of the fault reporting process in integer mode.

Module Fault Word
(described on page 116

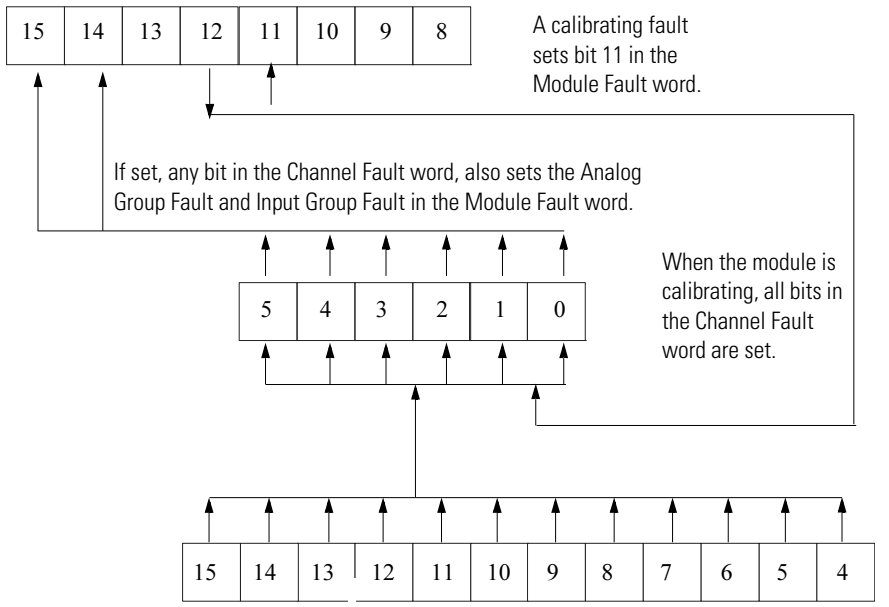
15 = AnalogGroupFault
14 = InGroupFault
12 = Calibrating
11 = Cal Fault
13, 10, 9 & 8 are not used by 1756-IF6I

Channel Fault Word
(described on page 116)

5 = Ch5Fault
4 = Ch4Fault
3 = Ch3Fault
2 = Ch2Fault
1 = Ch1Fault
0 = Ch0Fault

Channel Status Words
(one for each channel–described on page 117)

15 = Ch0Underrange
14 = Ch0Overrange
13 = Ch1Underrange
12 = Ch1Overrange
11 = Ch2Underrange
10 = Ch2Overrange
9 = Ch3Underrange
8 = Ch3Overrange
7 = Ch4Underrange
6 = Ch4Overrange
5 = Ch5Underrange
4 = Ch5Overrange


15 14 13 12 11 10 9 8
A calibrating fault sets bit 11 in the Module Fault word.
If set, any bit in the Channel Fault word, also sets the Analog Group Fault and Input Group Fault in the Module Fault word.
5 4 3 2 1 0
When the module is calibrating, all bits in the Channel Fault word are set.
15 14 13 12 11 10 9 8 7 6 5 4
Underrange and overrange conditions set the corresponding Channel Fault word bit for that channel.
41349

Module Fault Word Bits – Integer Mode

In integer mode, Module Fault word bits (bits 15-8) operate exactly as described in floating point mode. The table lists tags that can be examined in ladder logic to indicate when a fault has occurred:

Tag	Description
Analog Group Fault	This bit is set when any bits in the Channel Fault word are set. Its tag name is AnalogGroupFault.
Input Group Fault	This bit is set when any bits in the Channel Fault word are set. Its tag name is InputGroup.
Calibrating	This bit is set when any channel is being calibrated. When this bit is set, all bits in the Channel Fault word are set. Its tag name is Calibrating.
Calibration Fault	This bit is set when any of the individual Channel Calibration Fault bits are set. Its tag name is CalibrationFault.

Channel Fault Word Bits – Integer Mode

In integer mode, Channel Fault word bits operate exactly as described in floating point mode. The table lists the conditions that set all Channel Fault word bits.

Conditions for Channel Fault Word Bits	Displays
A channel is being calibrated.	'003F' for all bits.
A communications fault occurred between the module and its owner-controller.	'FFFF' for all bits.

Your logic can monitor the Channel Fault Word bit for a particular input to determine the state of that point.

Channel Status Word Bits – Integer Mode

The Channel Status word has the following differences when used in integer mode:

- Only Underrange and Overrange conditions are reported by the module.
- Alarming and Calibration Fault activities are not available, although the Calibration Fault bit in the Module Fault word will activate if a channel is not properly calibrated.
- There is only one Channel Status word for all six channels.

When the Calibration Fault bit (bit 7) is set in any of the words, the Calibration Fault bit (bit 9) is set in the Module Fault word. The table lists the conditions that set each of the words.

Tag (Status word)	Bit	Event that sets this tag
ChxUnderrange	Odd-numbered bits from bit 15…bit 5 (bit 15 represents channel 0). For a full listing of the channels these bits represent, page 115.	The underrange bit is set when the input signal at the channel is less than or equal to the minimum detectable signal. For more information on the minimum detectable signal for each module, see page 98. This bit also sets the appropriate bit in the Channel Fault word.
ChxOverrange	Even-numbered bits from bit 14…bit 4 (bit 14 represents channel 0). For a full listing of the channels these bits represent, page 115.	The overrange bit is set when the input signal at the channel is greater than or equal to the maximum detectable signal. For more information on the maximum detectable signal for each module, see page 98. This bit also sets the appropriate bit in the Channel Fault word.

Notes:

Temperature-measuring Analog Modules (1756-IR6I, 1756-IT6I, and 1756-IT6I2)

Introduction

This chapter describes features specific to temperature-measuring ControlLogix analog modules. These units linearize their respective sensor inputs into a temperature value. The 1756-IR6I uses ohms for temperature conversions and the two thermocouple modules (1756-IT6I, 1756-IT6I2) convert millivolts.

Topic	Page
Choose a Data Format	120
Temperature-measuring Module Features	121
Differences Between the 1756-IT6I and 1756-IT6I2 Modules	131
Use Module Block and Input Circuit Diagrams	136
Wire the Modules	138
1756-IT6I Wiring Example	139
1756-IT6I2 Wiring Example	140
Fault and Status Reporting	141
Fault Reporting in Floating Point Mode	142
Fault Reporting in Integer Mode	145

These modules also support features described in Chapter 3. See the table for some of these features.

Feature	Page
Removal and Insertion Under Power (RIUP)	36
Module Fault Reporting	36
Configurable Software	36
Electronic Keying	37
Access to System Clock for Timestamp Functions	44
Rolling Timestamp	44
Producer/Consumer Model	44
Status Indicator Information	45
Full Class I Division 2 Compliance	45
Agency Certification	45
Field Calibration	45
Sensor Offset	46
Latching of Alarms	46

Choose a Data Format

Data format determines how the data is returned from the module to the owner-controller and the features that are available to your application. You choose a data format when you choose a Communication Format.

You can choose one of these data formats:

- Integer mode
- Floating point mode

The table shows features that are available in each format.

Data Format	Features Available:	Features Not Available
Integer mode	Multiple input ranges Notch filter Real time sampling Cold junction temperature is on 1756-IT6I and 1756-IT6I2 modules only	Temperature linearization Process alarms Digital filtering Rate alarms
Floating point mode	All features	N/A

IMPORTANT Integer mode does not support temperature conversion on temperature-measuring modules. If you choose integer mode, the 1756-IR6I is strictly an ohms (Ω) module and the 1756-IT6I and 1756-IT6I2 are strictly millivolts (mV) modules.

For more information on input and output data formats, see page 205 in Chapter 10.

Temperature-measuring Module Features

The table lists features that are specific to the temperature-measuring modules.

Temperature-measuring Module Features

Feature	Page
Multiple Input Ranges	121
Notch Filter	122
Real Time Sampling	123
Underrange/Overrange Detection	123
Digital Filter	124
Process Alarms	125
Rate Alarm	126
10 Ohm Offset	126
Wire Off Detection	127
Sensor Type	128
Temperature Units	130
Cold Junction Compensation	132

Multiple Input Ranges

You can select from a series of operational ranges for each channel on your module. The range designates the minimum and maximum signals that are detectable by the module.

Possible Input Ranges

Module	Range
1756-IR6I	1…487 Ω 2…1000 Ω 4…2000 Ω 8…4080 Ω
1756-IT6I and 1756-IT6I2	-12…78 mV -12…30 mV

For an example of how to choose an input range for your module, see page 210.

Notch Filter

An Analog-to-Digital Convertor (ADC) filter removes line noise in your application for each channel.

Choose a notch filter that most closely matches the anticipated noise frequency in your application. Each filter time affects the response time of your module. Also, the highest frequency notch filter settings also limit the effective resolution of the channel.

IMPORTANT 60 Hz is the default setting for the notch filter.

The table lists the available notch filter settings.

Notch Filter Settings

Notch Setting	10 Hz	50 Hz	60 Hz (Default)	100 Hz	250 Hz	1000 Hz
Minimum Sample Time (RTS – Integer mode)(1)	102 ms	22 ms	19 ms	12 ms	10 ms	10 ms
Minimum Sample Time (RTS – Floating point mode)(2)	102 ms	25 ms	25 ms	25 ms	25 ms	25 ms
0…100% Step Response Time(3)	400 ms + RTS	80 ms + RTS	68 ms + RTS	40 ms + RTS	16 ms + RTS	4 ms + RTS
-3dB Frequency	3 Hz	13 Hz	15 Hz	26 Hz	66 Hz	262 Hz
Effective Resolution	16 bits	16 bits	16 bits	16 bits	15 bits	10 bits

(1) Integer mode must be used for RTS values lower than 25 ms. The minimum RTS value for the module will be dependent on the channel with the lowest notch filter setting.

(2) In mV mode, 50 ms minimum, if linearizing.

(3) Worst case settling time to 100% of a step change would include 0…100% step response time plus one RTS sample time.

To choose a notch filter, see page 210.

Real Time Sampling

This parameter instructs the module to scan its input channels and obtain all available data. After the channels are scanned, the module multicasts that data.

During module configuration, you specify a real time sampling (RTS) period and a requested packet tnterval (RPI) period. These features both instruct the module to multicast data, but only the RTS feature instructs the module to scan its channels before multicasting.

For more information on real time sampling, see page 24. For an example of how to set the RTS rate, see page 210.

Underrange/Overrange Detection

This feature detects when a temperature-measuring input module is operating beyond limits set by the input range. For example, if you are using the 1756-IR6I module in the 2…1000 Ω input range and the module resistance increases to 1050 Ω, the overrange detection detects this condition.

The table lists the input ranges of non-isolated input modules and the lowest/highest signal available in each range before the module detects an underrange/overrange condition.

Low and High Signal Limits on Temperature-measuring Input Modules

Input Module	Available Range	Lowest Signal in Range	Highest Signal in Range
1756-IR6I	1…487 Ω	0.859068653 Ω	507.862 Ω
	2…1000 Ω	2 Ω	1016.502 Ω
	4…2000 Ω	4 Ω	2033.780 Ω
	8…4020 Ω	8 Ω	4068.392 Ω
1756-IT6I and 1756-IT6I2	-12…30 mV	-15.80323 mV	31.396 mV
	-12…78 mV	-15.15836 mV	79.241 mV

IMPORTANT Be careful when 'disabling all alarms' on the channel because it also disables the underrange/overrange detection feature. If alarms are disabled, overrange/underrange is zero and the only way you can discover a wire-off detection is from the input value itself. If you need to detect a wire-off status, do not 'disable all alarms'.

We recommend that you disable only unused channels so extraneous alarm bits are not set.

Digital Filter

IMPORTANT The digital filter is available only in applications using floating point mode.

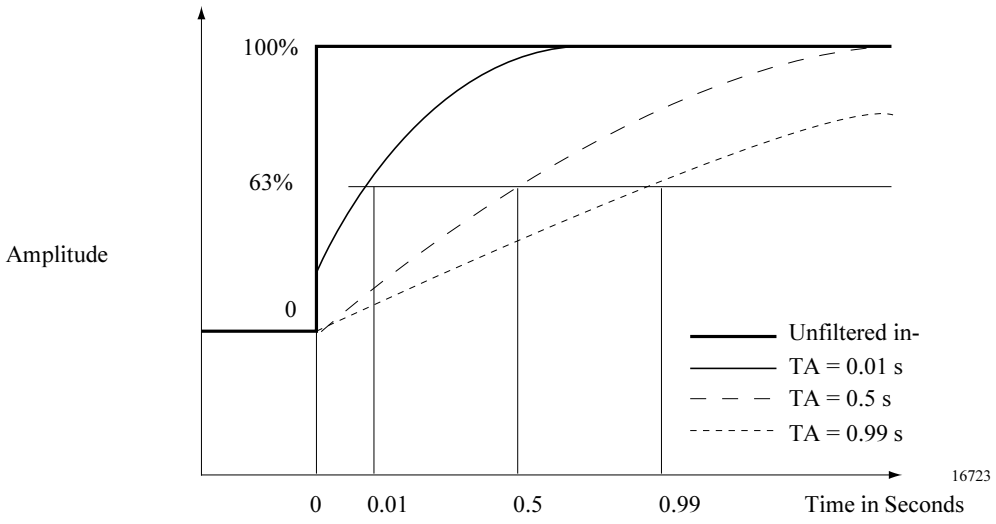
The digital filter smooths input data noise transients on each input channel. This value specifies the time constant for a digital first order lag filter on the input. It is specified in units of milliseconds. A value of 0 disables the filter.

The digital filter equation is a classic first order lag equation.

$$Yn = Yn\text{-}1 + \frac{[\Delta t]}{\Delta t + TA} (X_n - Y_n\text{-}1)$$

Yn = present output, filtered peak voltage (PV)
Yn-1 = previous output, filtered PV
Δt = module channel update time (seconds)
TA = digital filter time constant (seconds)
Xn = present input, unfiltered PV

Using a step input change to illustrate the filter response, you can see that when the digital filter time constant elapses, 63.2% of the total response is reached. Each additional time constant achieves 63.2% of the remaining response.



To see how to set the digital filter, see page 210.

Process Alarms

Process alarms alert you when the module has exceeded configured high or low limits for each channel. You can latch process alarms. These are set at four user configurable alarm trigger points.

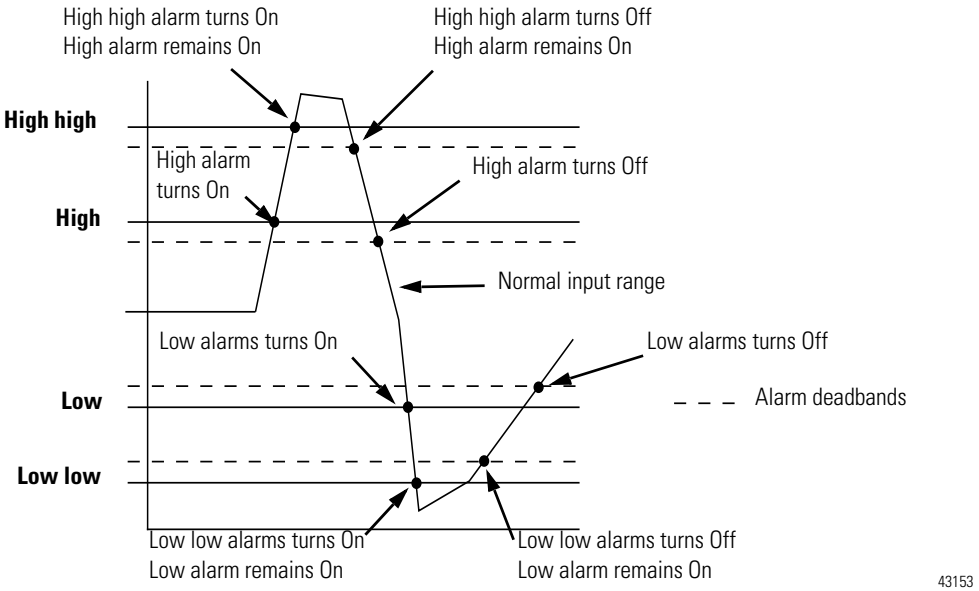
- High high
- High
- Low
- Low low

IMPORTANT Process alarms are available only in applications using floating point mode. The values for each limit are entered in scaled engineering units.

Alarm Deadband

You may configure an alarm deadband to work with these alarms. The deadband allows the process alarm status bit to remain set, despite the alarm condition disappearing, as long as the input data remains within the deadband of the process alarm.

The illustration shows input data that sets each of the four alarms at some point during module operation. In this example, latching is disabled; therefore, each alarms turns Off when the condition that caused it to set ceases to exist.



To see how to set process alarms, see page 210.

Rate Alarm

IMPORTANT You must use RSLogix 5000 software, version 12 or later, and module firmware revision 1.10 or later, to use the rate alarm for a non-ohm input on the 1756-IR6I module and a non-millivolt input on the 1756-IT6I and 1756-IT6I2 modules.

The rate alarm triggers if the rate of change between input samples for each channel exceeds the specified trigger point for that channel. This feature is available only in applications using floating point.

EXAMPLE If you set a 1756-IT6I2 module (with normal scaling in Celsius) to a rate alarm of 100.1 °C/s, the rate alarm only triggers if the difference between measured input samples changes at a rate > 100.1 °C/s.

If the module's RTS is 100 ms (that is, sampling new input data every 100 ms) and at time 0, the module measures 355 °C and at time 100 ms measures 363 °C, the rate of change is (363…355 °C) / (100 ms) = 80 °C/s. The rate alarm would not set as the change is less than the trigger point of 100.1 °C/s.

If the next sample taken is 350.3 °C, the rate of change is (350.3…363 °C)/(100 ms)=-127 °C/s. The absolute value of this result is > 100.1 °C/s, so the rate alarm will set. Absolute value is used because rate alarm checks for the magnitude of the rate of change being beyond the trigger point, whether a positive or negative excursion.

To see how to set the rate alarm, see page 210.

10 Ohm Offset

With this feature, you can compensate for a small offset error in a 10 Ω copper RTD. Values can range from -0.99…0.99 Ω in units of 0.01 Ω For example, if the resistance of a copper RTD used with a channel is 9.74 Ω at 25 °C, you would enter -0.26 in this field.

To see how to set the 10 Ohm Offset, see page 215.

Wire Off Detection

The ControlLogix temperature-measuring modules alert you when a wire has been disconnected from one of their channels. When a wire off condition occurs, two events occur:

- Input data for that channel changes to a specific scaled value.
- A fault bit is set in the owner-controller that may indicate the presence of a wire off condition.

IMPORTANT Be careful when 'disabling all alarms' on the channel because it also disables the underrange/overrange detection feature. If alarms are disabled, overrange/underrange is zero and the only way you can discover a wire-off detection is from the input value itself. If you need to detect a wire-off status, do not 'disable all alarms'.

We recommend that you disable only unused channels so extraneous alarm bits are not set.

Because these modules can each be used in various applications, differences exist when a wire off condition is detected in each application. The table lists the differences that occur when a wire off condition occurs in various applications.

Wire Off Conditions

In this application	The following causes a wire off condition	And if the wire off condition is detected, this occurs
1756-IR6I Module in Temperature Applications	Either of the following: 1. When only the wire connected to terminal A is lost. 2. When any other combination of wires are disconnected from the module. See page 138 for a wiring diagram.	If possibility number 1 (in the previous column) is the cause: • Input data for the channel changes to the highest scaled temperature value associated with the selected RTD type. • The ChxOverrrange (x=channel number) tag is set to 1. If possibility number 2 (in the previous column) is the cause: • Input data for the channel changes to the lowest scaled temperature value associated with the selected RTD type. • The ChxUnderrange (x=channel number) tag is set to 1.
1756-IR6I Module in Ohms Applications	Either of the following: 1. When only the wire connected to terminal A is lost. 2. When any other combination of wires are disconnected from the module. See page 138 for a wiring diagram.	If possibility number 1 (in the previous column) is the cause: • Input data for the channel changes to the highest scaled ohm value associated with the selected ohms range. • The ChxOverrange (x=channel number) tag is set to 1. If possibility number 2 (in the previous column) is the cause: • Input data for the channel changes to the lowest scaled ohm value associated with the selected ohms range. • The ChxUnderrange (x=channel number) tag is set to 1.

Wire Off Conditions

In this application	The following causes a wire off condition	And if the wire off condition is detected, this occurs
1756-IT6I or 1756-IT6I2 Module in Temperature Applications	A wire is disconnected from the module.	• Input data for the channel changes to the highest scaled temperature value associated with the selected thermocouple type. • The ChxOverrange (x=channel number) tag is set to 1.
1756-IT6I Module or 1756-IT6I2 in Millivolt Applications		• Input data for the channel changes to the scaled value associated with the overrange signal value of the selected operational range in floating point mode (maximum possible scaled value) or 32,767 counts in integer mode. • The ChxOverrange (x=channel number) tag is set to 1.

Sensor Type

Three analog modules, the RTD (1756-IR6I) and Thermocouple (1756-IT6I and 1756-IT6I2), lets you configure a sensor type for each channel that linearizes the analog signal into a temperature value. The RTD module linearizes ohms into temperature and the Thermocouple modules linearize millivolts into temperature.

IMPORTANT Sensor type modules can only linearize signals to temperature values in the floating point mode.

The table lists the sensors that are available for your application.

Available Sensors for Temperature Measuring Modules

Module	Available sensors or thermocouples
1756-IR6I	10Ω - Copper 427 type. 100Ω - Platinum 385, Platinum 3916, and Nickel 618 types. 120Ω - Nickel 618 and Nickel 672 types. 200Ω - Platinum 385, Platinum 3916, and Nickel 618 types. 500Ω - Platinum 385, Platinum 3916, and Nickel 618 types. 1000Ω - Platinum 385 and Platinum 3916 types.
1756-IT6I	B, E, J, K, R, S, T, N, C.
1756-IT6I2	B, E, J, K, R, S, T, N, C, D, TXK/XK (L).

When you select any of the sensor or thermocouple types (listed in the table) during configuration, RSLogix 5000 software uses the default values in the scaling box.

Default Signal and Engineering Values in RSLogix 5000

1756-IR6I		1756-IT6I and 1756-IT6I2	
Low signal = 1	Low engineering = 1	Low signal = -12	Low engineering = -12
High signal = 487	High engineering = 487	High signal = 78	High engineering = 78

IMPORTANT The module sends back temperature values over the entire sensor range as long as the low signal value equals the low engineering value and the high signal value equals the high engineering value. The actual numbers used in the signal and engineering fields are irrelevant as long as they are equal.

The table displays the temperature range for each 1756-IR6I sensor type.

Temperature Limits for 1756-IR6I Sensor Types

1756-IR6I Sensor	Copper 427	Nickel 618	Nickel 672	Platinum 385	Platinum 3916
Low temperature	-200.0 °C -328.0 °F	-60.0 °C -76.0 °F	-80.0 °C -112.0 °F	-200.0 °C -328.0 °F	-200.0 °C -328.0 °F
High temperature	260.0 °C 500.0 °F	250.0 °C 482.0 °F	320.0 °C 608.0 °F	870.0 °C 1598.0 °F	630.0 °C 1166.0 °F

To see how to choose an RTD sensor type, see page 215.

The table displays the temperature range for each 1756-IT6I and 1756-IT6I2 sensor type.

Temperature Limits for 1756-IT6I and 1756-IT6I2 Sensor Types

Thermocouple	B	C	E	J	K	N	R	S	T	D[1]	TXK/XK (L)[1]
Low temperature	300.0 °C 572.0 °F	0.0 °LC 32.0 °F	-270.0 °C -454.0 °F	-210.0 °C -346.0 °F	-270.0 °C -454.0 °F	-270.0 °C -454.0 °F	-50.0 °C -58.0 °F	-50.0 °C -58.0 °F	-270.0 °C -454.0 °F	0 °C 32.0 °F	-200 °C -328 °F
High temperature	1820.0 °C 3308.0 °F	2315.0 °C 4199.0 °F	1000.0 °C 1832.0 °F	1200.0 °C 2192.0 °F	1372.0 °C 2502.0 °F	1300.0 °C 2372.0 °F	1768.1 °C 3215.0 °F	1768.1 °C 3215.0 °F	400.0 °C 752.0 °F	2320 °C 4208 °F	800 °C 1472 °F

(1) Sensor types D and L are available only on the 1756-IT6I2 module.

IMPORTANT The table lists temperature limits for sensors using the -12…78 mV range only. When the -12…30 mV range is used, temperature limits are truncated to the temperature value that corresponds to 30 mV.

To see how to choose a thermocouple sensor type, see page 216.

Temperature Units

The 1756-IR6I, 1756-IT6I and 1756-IT6I2 modules provide the choice of working in Celsius or Fahrenheit. This choice affects all channels per module.

To see how to choose temperature units, see page 215.

Input Signal to User Count Conversion

Integer mode does not support temperature conversion on temperature-measuring modules. However, this mode can be used by the 1756-IT6I and 1756-IT6I2 modules to calculate user counts for both available millivolt ranges.

The straight line formulas that can be used to calculate or program a Compute (CPT) instruction are shown in the table.

Available Range	User Count Formula
-12…30 mV	y = 1388.4760408167676x-10825.593777483234 where y = counts; x = mV
12…78 mV	y = 694.2314015688241x-22244.5904917152 where y = counts; x = mV

For example, if you have 24 mV in the -12…30 mV range, the user counts = 22498. Counts = -20856 for 2 mV in the 12…78 mV range.

For a table with related values, refer to ControlLogix 1756-IT6I and 1756-IT6I2 mV Input Signal to User Count Conversion, Knowledgebase Technical Note ID 41567.

Wire Length Calculations

The rule for determining the maximum thermocouple lead length without error is that the lead length's error should be less than half of the module resolution. This error implies no error is observed nor is recalibration required.

The resolution for the 1756-IT6I and 1756-IT6I2 module, respectively, is:

-12…30 mV range = 0.7 uv/bit
-12…78 mV range = 1.4 uv/bit

Based on the schematic on page 137, the module leakage per open-wire current is the bias voltage/pull-up resistance = 0.44V / 20 MΩ = 22 nA. Hence, the maximum thermocouple loop resistance is the sum of total loop resistance = both leads.

Using this equation, for the -12…30 mV range the maximum lead resistance is 16 Ω for a maximum of half resolution error (1/2*(0.7uv/bit) / 22 nA).

For the -12…78 mV range, the maximum lead resistance is 32 Ω for a maximum of half resolution error (1/2*(1.4uv/bit) / 22 nA).

For more information, refer to 1756-IT6I and 1756-IT6I2 Thermocouple Lead Length Calculations, Knowledgebase Technical Note ID 59091.

Differences Between the 1756-IT6I and 1756-IT6I2 Modules

The 1756-IT6I and 1756-IT6I2 modules support grounded and ungrounded thermocouples. However, in addition to offering access to two more thermocouple types (D and TXK/XK [L]), the 1756-IT6I2 module offers the following:

- A greater cold-junction compensation accuracy
- Improved module accuracy

  See page 135 for details.

While the 1756-IT6I module can report cold junction temperature differences between channels as high as 3 °C from the actual temperature, the 1756-IT6I2 module, because it has two cold-junction sensors (CJS), reduces the potential cold-junction error from actual temperature to 0.3 °C.

It's important that you check that the CJS is fitted locally or remotely, and enabled accordingly in the module channel configuration. If the CJS is not fitted or if the sensor wiring leads are incorrect (for example, swapped over at the thermocouple cards input), there's a possibility of a negative or positive temperature fluctuation when the thermocouple sensor is warmed.

The table lists the cold junction error from actual temperature, depending on the type of cold junction compensation that is used.

Cold-junction Compensation Types

If you use this module	With this type of cold junction compensation	The cold junction error from actual temperature is
1756-IT6I2	Two cold-junction sensors on an RTB	+/-0.3 °C (32.54 °F)
1756-IT6I2	IFM	+/-0.3 °C (32.54 °F)
1756-IT6I	One cold-junction sensor on an RTB	+/-3.2 °C (37.76 °F), max(1)
1756-IT6I	IFM	+/-0.3 °C (32.54 °F)

(1) The cold junction error varies for each channel but 3.2 °C (37.76 °F) is the maximum error any channel will show.

Cold Junction Compensation

When using the thermocouple (1756-IT6I and 1756-IT6I2) modules, you must account for additional voltage that may alter the input signal. A small voltage generates at the junction of the thermocouple field wires and the screw terminations of an RTB or IFM. This thermoelectric effect alters the input signal.

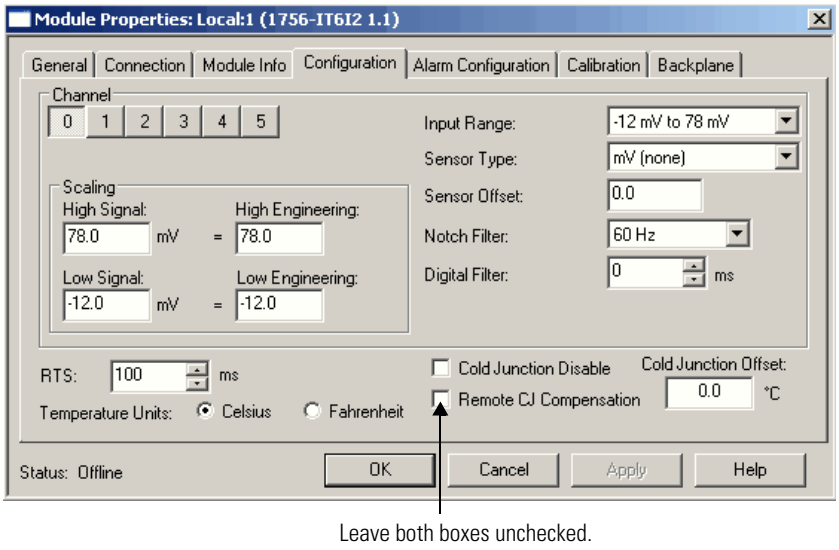
To accurately compensate the input signal from your module, you must use a cold junction sensor (CJS) to account for the increased voltage. Because there are differences if you choose to connect sensors via an RTB or IFM, you must configure the module (via RSLogix 5000 software) to work with the type of CJS used in your application.

Connecting a Cold Junction Sensor Via a Removable Terminal Block

When you connect a CJS to your thermocouple module via an RTB, the following occurs, depending on module type:

- The 1756-IT6I module uses one CJS in the middle of the module and estimates temperature deviation elsewhere on the connector.
- The 1756-IT6I2 module uses two CJSs at the top and bottom of the module and calculates temperature at each channel's input terminals; this usage of multiple sensors results in increased accuracy.

If you connect a CJS via an RTB, configure the module as shown on the Module Properties Configuration tab.

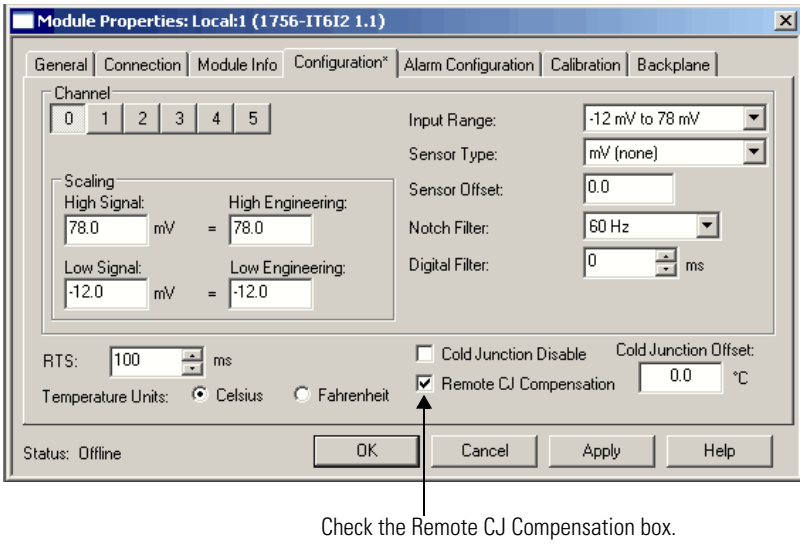


See page 134 for how to connect a CJS to either thermocouple module.

Connecting a Cold Junction Sensor Via an Interface Module

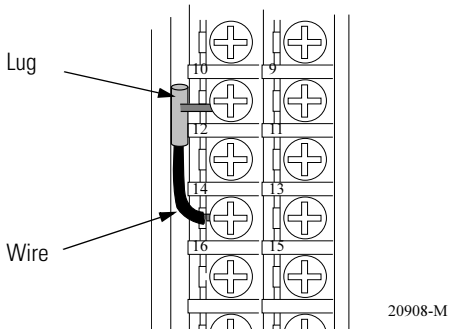
The IFMs use an isothermal bar to maintain a steady temperature at all module terminations. When you use the IFM, we recommend you mount it so that the black anodized aluminum bar is in the horizontal position.

If you connect a CJS via an IFM, configure the module as shown on the Module Properties Configuration tab



Connecting a Cold Junction Sensor to the 1756-IT6I Module

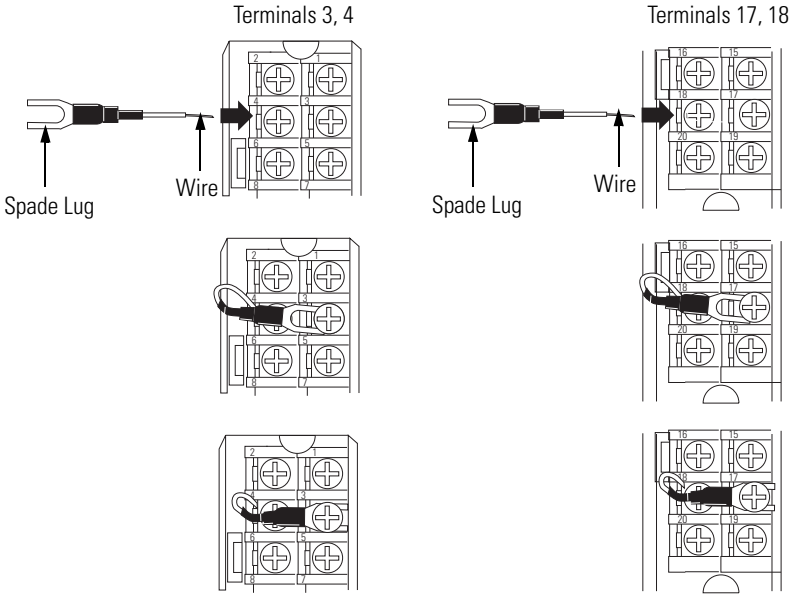
You must connect the CJS to the 1756-IT6I module at terminals 10 and 14. To ease installation, wire terminal #12 (RTN-3) before connecting the cold junction sensor.



Contact your local distributor or Rockwell Automation sales representative to order additional sensors.

Connecting a Cold Junction Sensor to the 1756-IT6I2 Module

You must connect two CJSs to the 1756-IT6I2 when using an RTB. The additional CJS offers greater accuracy when measuring temperature on the module. Connect the cold junction sensors to terminals 3, 4, 17, 18 as shown in the illustrations.



Contact your local distributor or Rockwell Automation sales representative to order additional sensors.

Cold Junction Disable Option

The Cold Junction Disable box on the Module Properties Configuration tab disables cold junction compensation on all module channels. Typically, this option is used only in systems that have no thermoelectric effect, such as test equipment in a controlled lab.

In most applications, we recommend that you do not use the cold junction disable option.

Cold Junction Offset Option

The Cold Junction Offset box on the Module Properties Configuration Tab lets you make module-wide adjustments to cold junction compensation values. If you know that your cold junction compensation values are consistently inaccurate by some level, for example, 1.2 °C (34.16 °F), you can type the value into the box to account for this inaccuracy.

Improved Module Accuracy

The 1756-IT6I2 offers improved Gain Drift with Temperature and Module Error over Temperature Range specifications when compared to the 1756-IT6I module. The table highlights the differences.

Cat. No.	Gain Drift with Temperature[1]	Module Error over Temperature Range[1]
1756-IT6I	80 ppm	0.5%
1756-IT6I2	25 ppm	0.15%

(1) For a detailed explanation of this specification, see Appendix E.

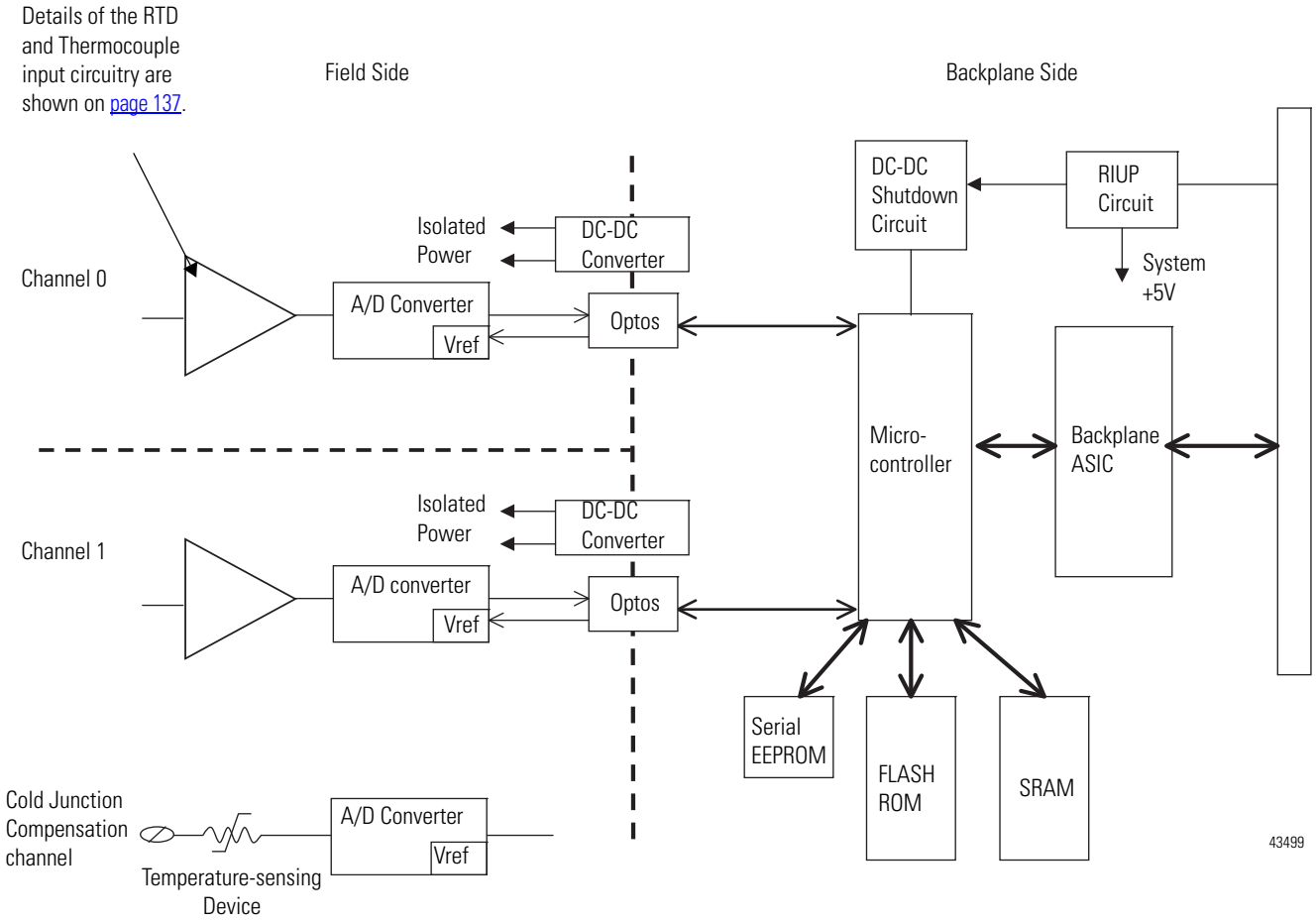
For a full listing of these module's specifications, see Appendix A.

Use Module Block and Input Circuit Diagrams

This section shows the 1756-IR6I, 1756-IT6I and 1756-IT6I2 modules' block diagrams and input circuit diagrams.

1756-IR6I, 1756-IT6I and 1756-IT6I2 Module Block Diagram

This diagram shows two channels. There are six channels on the temperature-measuring modules.



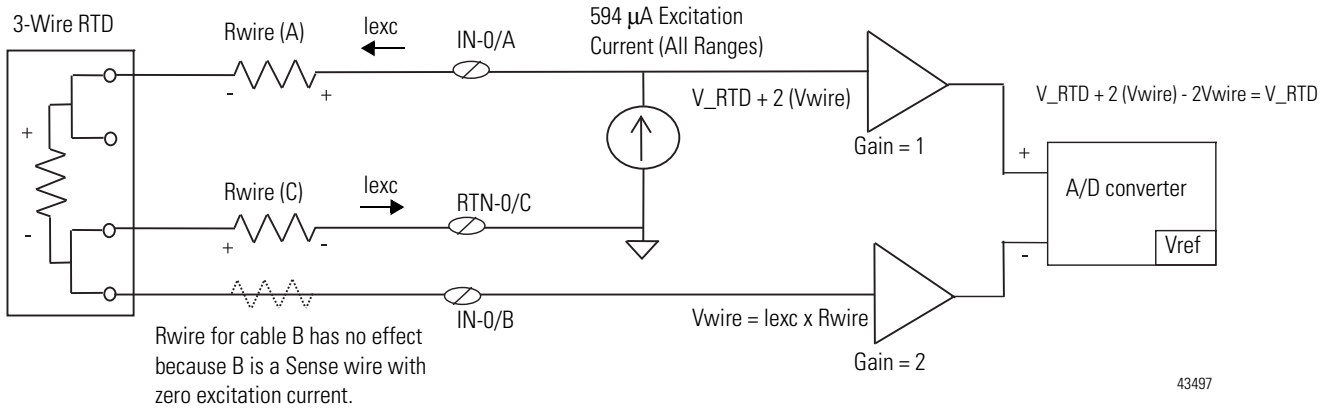
IMPORTANT: The cold junction compensation (CJC) channel is used on Thermocouple modules only. The 1756-IT6I module has one CJC channel, and the 1756-IT6I2 module has two CJC channels.

= Channel Isolation

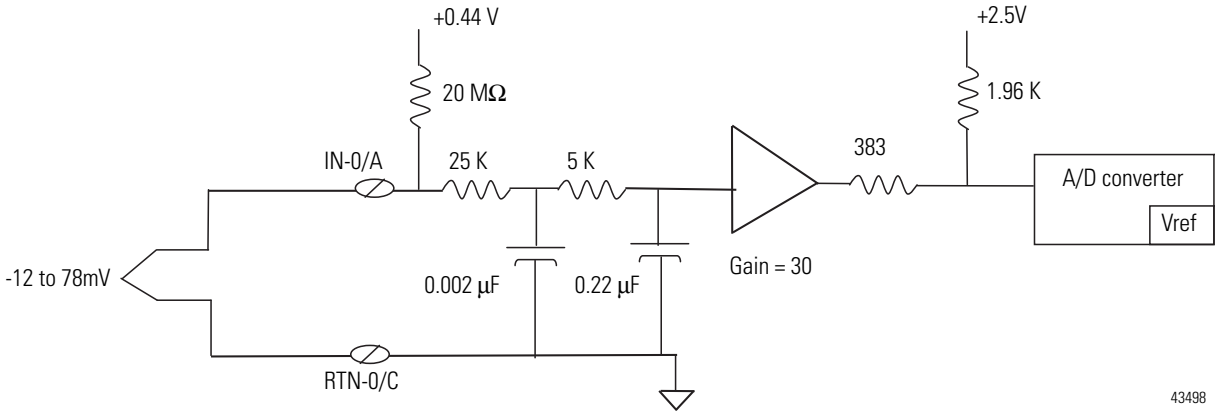
Field-side Circuit Diagrams

The diagrams show field-side circuitry for the 1756-IR6I, 1756-IT6I, and 1756-IT6I2 modules.

1756-IR6I Input Circuit



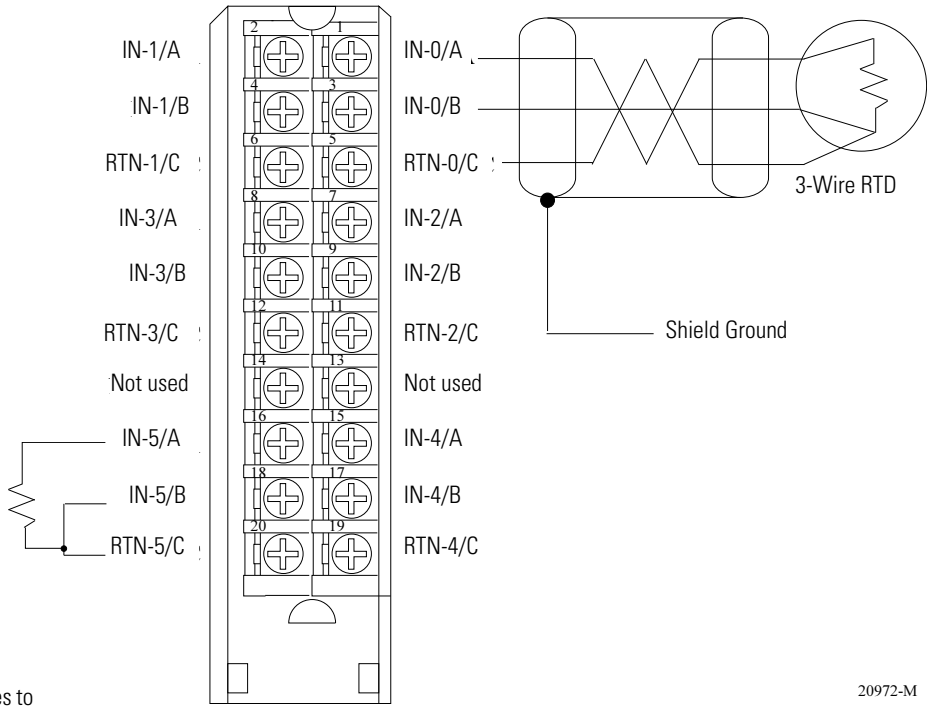
1756-IT6I and 1756-IT6I2 Input Circuit



Wire the Modules

The illustrations show wiring examples for the 1756-IR6I, 1756-IT6I, and 1756-IT6I2 modules.

1756-IR6I 3-Wire RTD wiring example

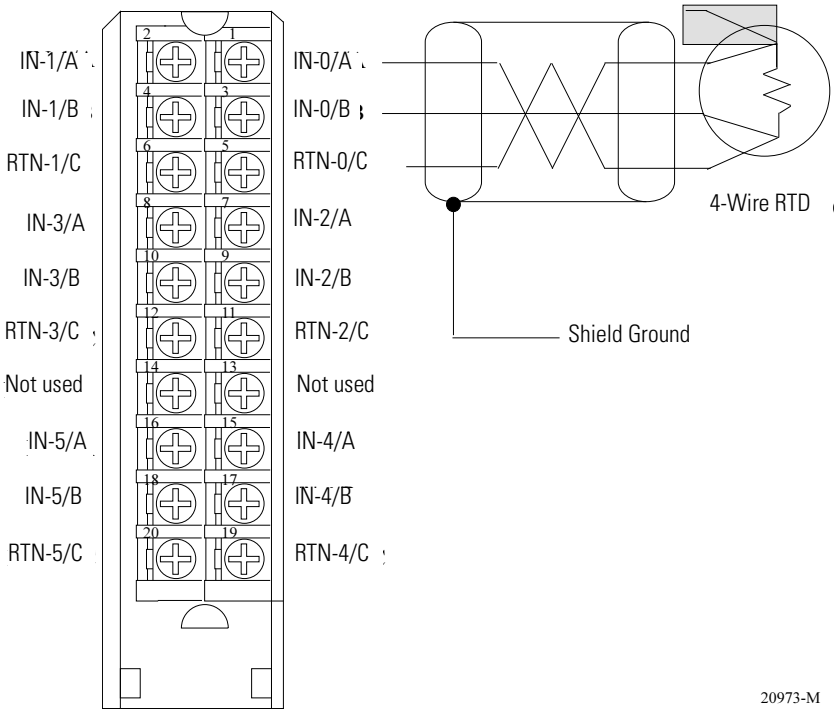


IMPORTANT: For two-wire resistor applications including calibration, make sure IN-x/B and RTN-x/C are shorted together as shown.

NOTES:

1. Do not connect more than two wires to any single terminal.

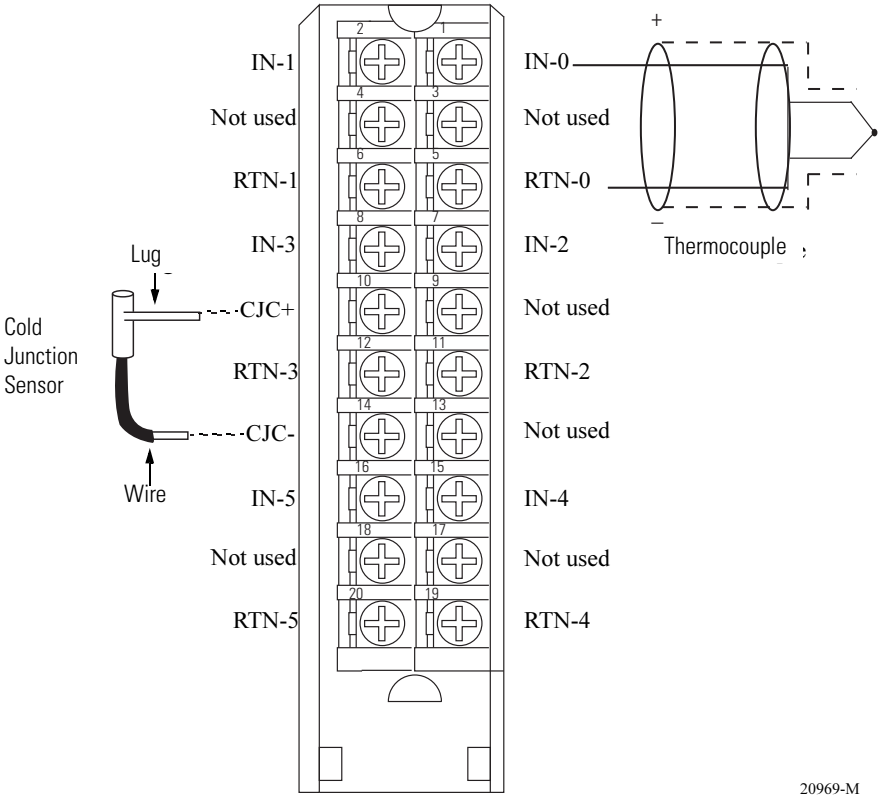
1756-IR6I 4-Wire RTD wiring example



NOTES:

1. Do not connect more than two wires to any single terminal.
2. Wiring is exactly the same as the 3-Wire RTD with one wire left open.

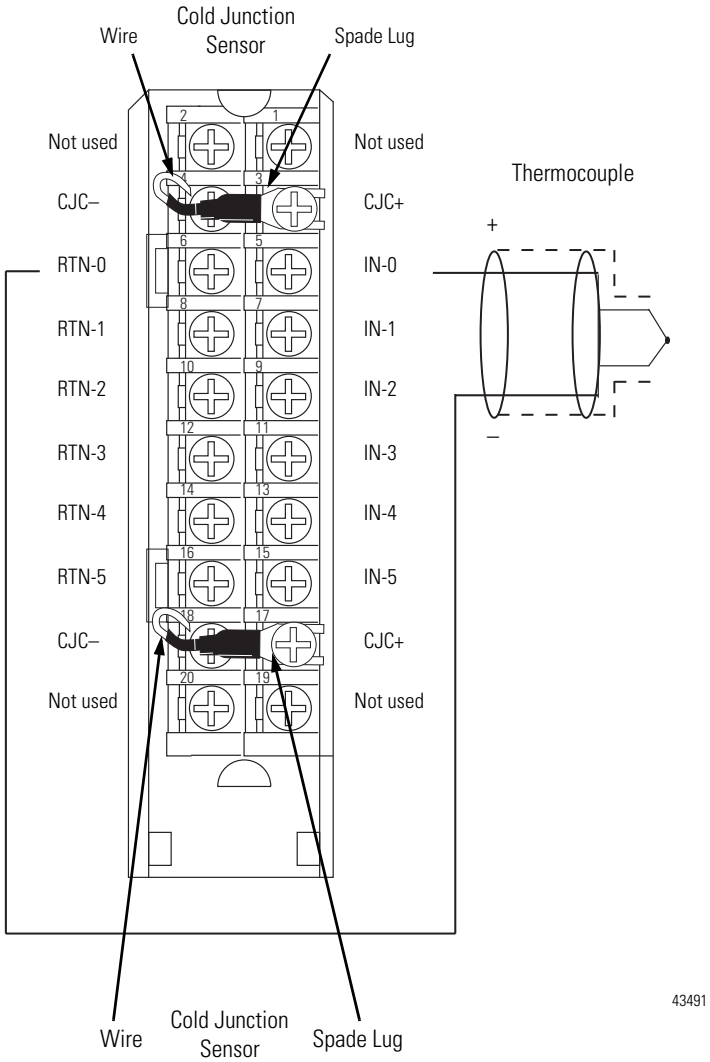
1756-IT6I Wiring Example



NOTES:

1. Do not connect more than two wires to any single terminal.

1756-IT6I2 Wiring Example



NOTES:

1. Do not connect more than two wires to any single terminal.

Fault and Status Reporting

The 1756-IR6I, 1756-IT6I, and 1756-IT6I2 modules multicast status and fault data to the owner and/or listening controller with its channel data. The fault data is arranged in such a manner as to let you choose the level of granularity desired for examining fault conditions.

Three levels of tags work together to provide increasing degree of detail as to the specific cause of faults on the module.

The table lists tags that can be examined in ladder logic to indicate when a fault has occurred.

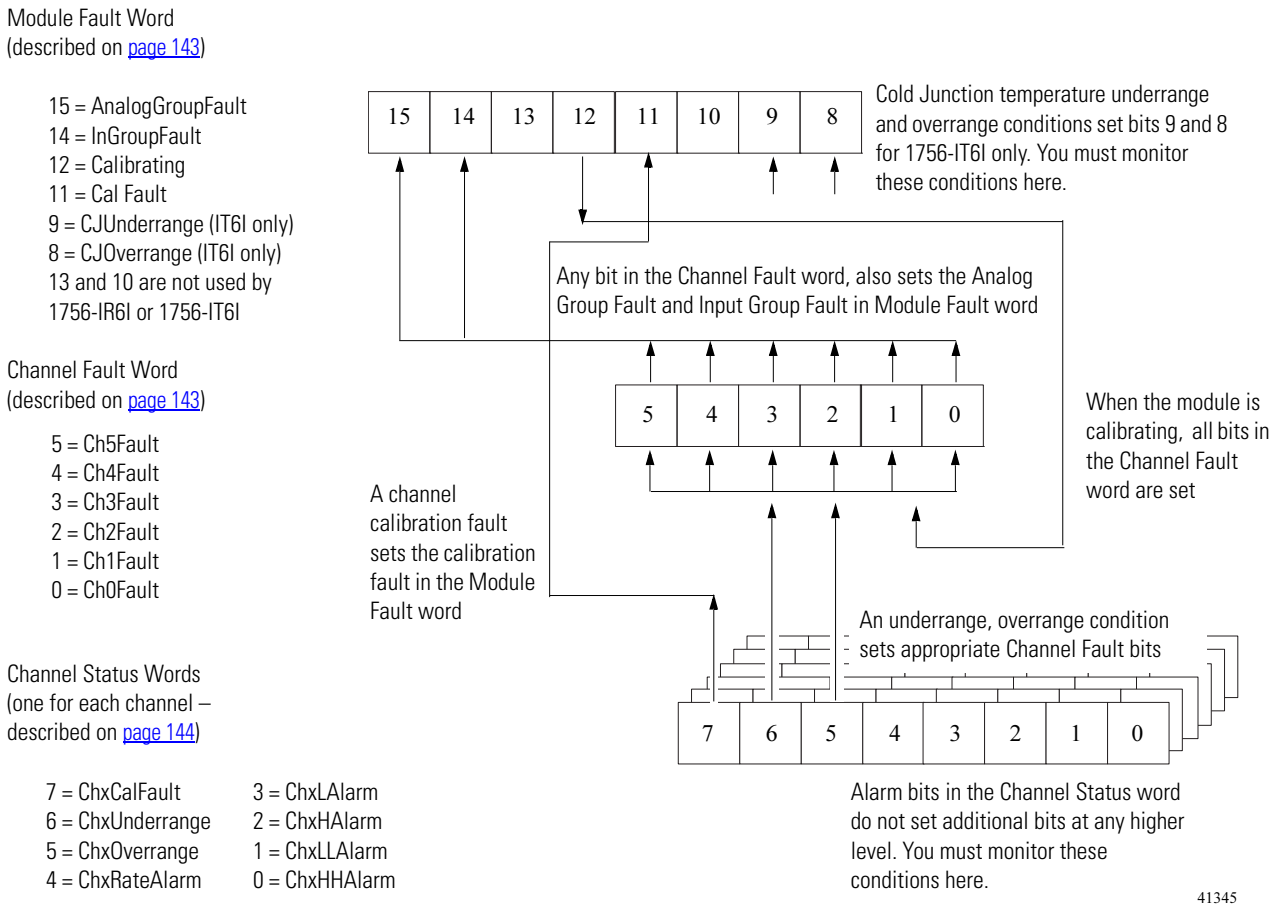
Fault Word Tags

Tag	Description
Module Fault Word	This word provides fault summary reporting. Its tag name is ModuleFaults.
Channel Fault Word	This word provides underrange, overrange, and communication fault reporting. Its tag name is ChannelFaults.
Channel Status Words	This word provides individual channel underrange and overrange fault reporting for process alarms, rate alarms, and calibration faults. Its tag name is ChxStatus.

IMPORTANT Differences exist between floating point and integer modes as they relate to module fault reporting. These differences are explained in the following sections.

Fault Reporting in Floating Point Mode

The illustration offers an overview of the fault reporting process in floating point mode.


Module Fault Word
(described on page 143)
15 = AnalogGroupFault
14 = InGroupFault
12 = Calibrating
11 = Cal Fault
9 = CJUnderrange (IT6I only)
8 = CJOverrange (IT6I only)
13 and 10 are not used by
1756-IR6I or 1756-IT6I
Channel Fault Word
(described on page 143)
5 = Ch5Fault
4 = Ch4Fault
3 = Ch3Fault
2 = Ch2Fault
1 = Ch1Fault
0 = Ch0Fault
Channel Status Words
(one for each channel –
described on page 144)
7 = ChxCalFault
6 = ChxUnderrange
5 = ChxOverrange
4 = ChxRateAlarm
3 = ChxLAlarm
2 = ChxHAlarm
1 = ChxLLAlarm
0 = ChxHHAlarm
15 14 13 12 11 10 9 8
Cold Junction temperature underrange and overrange conditions set bits 9 and 8 for 1756-IT6I only. You must monitor these conditions here.
Any bit in the Channel Fault word, also sets the Analog Group Fault and Input Group Fault in Module Fault word
5 4 3 2 1 0
When the module is calibrating, all bits in the Channel Fault word are set
A channel calibration fault sets the calibration fault in the Module Fault word
An underrange, overrange condition sets appropriate Channel Fault bits
7 6 5 4 3 2 1 0
Alarm bits in the Channel Status word do not set additional bits at any higher level. You must monitor these conditions here.
41345

Module Fault Word Bits – Floating Point Mode

Bits in this word provide the highest level of fault detection. A nonzero condition in this word reveals that a fault exists on the module. You can examine further down to isolate the fault.

The table lists tags that are found in the Module Fault Word.

Module Fault Word Tags

Tag	Description
Analog Group Fault	This bit is set when any bits in the Channel Fault word are set. Its tag name is AnalogGroupFault.
Input Group Fault	This bit is set when any bits in the Channel Fault word are set. Its tag name is InputGroup.
Calibrating	This bit is set when any channel is being calibrated. When this bit is set, all bits in the Channel Fault word are set. Its tag name is Calibrating.
Calibration Fault	This bit is set when any of the individual Channel Calibration Fault bits are set. Its tag name is CalibrationFault.
Cold Junction Underrange – 1756-IT6I and 1756-IT6I2only	This bit is set when the ambient temperature around the cold junction sensor is below 0 ^{o}C. Its tag name is CJUnderrange.
Cold Junction Overrange – 1756-IT6I and 1756-IT6I2only	This bit is set when the ambient temperature around the cold junction sensor is above 86 ^{o}C. Its tag name is CJOverrange.

Channel Fault Word Bits – Floating Point Mode

During normal module operation, bits in the Channel Fault word are set if any of the respective channels has an Under or Overrange condition. Checking this word for a nonzero value is a quick way to check for Under or Overrange conditions on the module.

The table lists the conditions that set all Channel Fault word bits:

Channel Fault Word Conditions

This condition sets all Channel Fault word bits	And causes the module to display the following in the Channel Fault word bits
A channel is being calibrated.	"003F" for all bits
A communication fault occurred between the module and its owner-controller.	"FFFF" for all bits.

Your logic can monitor the Channel Fault Word bit for a particular input to determine the state of that point.

Channel Status Word Bits – Floating Point Mode

Any of the six Channel Status words, one for each channel, will display a nonzero condition if that particular channel has faulted for the conditions listed below. Some of these bits set bits in other Fault words. When the Underrange and Overrange bits (bits 6 and 5) in any of the words are set, the appropriate bit is set in the Channel Fault word.

When the Calibration Fault bit (bit 7) is set in any of the words, the Calibration Fault bit (bit 9) is set in the Module Fault word. The table lists the conditions that set each of the word bits.

Channel Status Word Conditions

Tag (Status word)	Bit	Event that sets this tag
ChxCalFault	Bit 7	This bit is set if an error occurs during calibration for that channel, causing a bad calibration. This bit also sets bit 9 in the Module Fault word.
Underrange	Bit 6	This bit is set when the input signal at the channel is less than or equal to the minimum detectable signal. For more information on the minimum detectable signal for each module, see page 123. This bit also sets the appropriate bit in the Channel Fault word.
Overrange	Bit 5	This bit is set when the input signal at the channel is greater than or equal to the maximum detectable signal. For more information on the maximum detectable signal for each module, see page 123. This bit also sets the appropriate bit in the Channel Fault word.
ChxRateAlarm	Bit 4	This bit is set when the input channel's rate of change exceeds the configured Rate Alarm parameter. It remains set until the rate of change drops below the configured rate. If latched, the alarm remains set until it is unlatched.
ChxLAlarm	Blt 3	This bit is set when the input signal moves beneath the configured Low Alarm limit. It remains set until the signal moves above the configured trigger point. If latched, the alarm will remain set until it is unlatched. If a deadband is specified, the alarm will also remain set as long as the signal remains within the configured deadband.
ChxHAlarm	Bit 2	This bit is set when the input signal moves above the configured High Alarm limit. It remains set until the signal moves below the configured trigger point. If latched, the alarm remains set until it is unlatched. If a deadband is specified, the alarm also remains set as long as the signal remains within the configured deadband.
ChxLLAlarm	Bit 1	This bit is set when the input signal moves beneath the configured Low-Low Alarm limit. It remains set until the signal moves above the configured trigger point. If latched, the alarm remains set until it is unlatched. If a deadband is specified, the alarm also remains latched as long as the signal remains within the configured deadband.
ChxHHAlarm	Bit 0	This bit is set when the input signal moves above the configured High-High Alarm limit. It remains set until the signal moves below the configured trigger point. If latched, the alarm remains set until it is unlatched. If a deadband is specified, the alarm also remains latched as long as the signal remains within the configured deadband.

Fault Reporting in Integer Mode

The illustration offers an overview of the fault reporting process in integer mode.

Module Fault Word
(described on page 146)

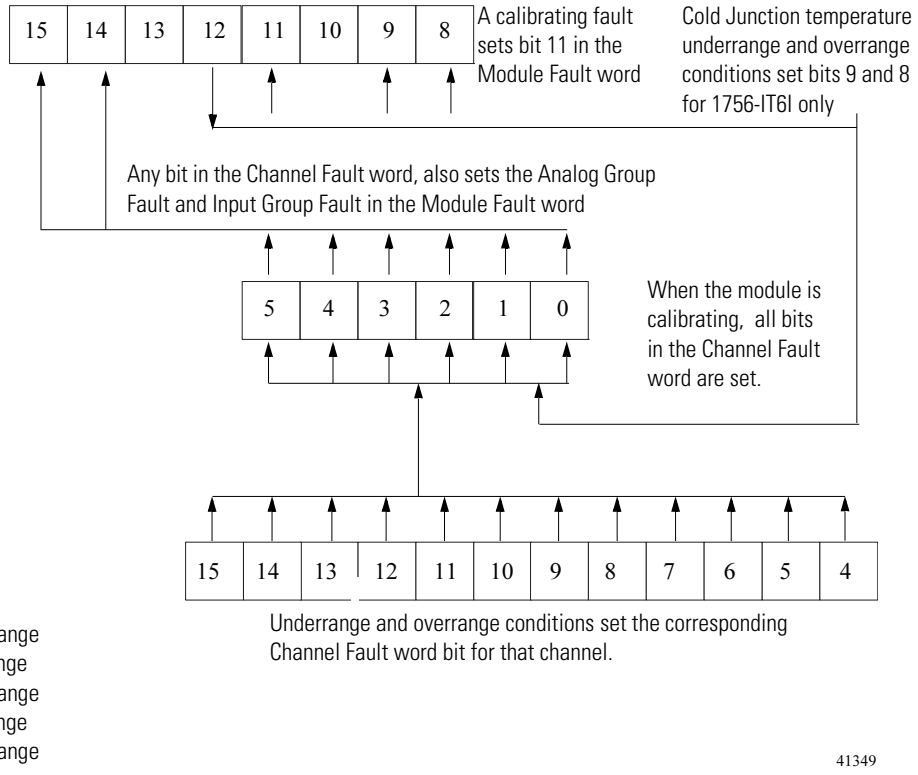
15 = AnalogGroupFault
14 = InGroupFault
12 = Calibrating
11 = Cal Fault
9 and 8 = CJUnderOver
13 and 10 are not used by 1756-IR6I or IT6I

Channel Fault Word
(described on page 146)

5 = Ch5Fault
4 = Ch4Fault
3 = Ch3Fault
2 = Ch2Fault
1 = Ch1Fault
0 = Ch0Fault

Channel Status Words
(described on page 147)

15 = Ch0Underrange
14 = Ch0Overrange
13 = Ch1Underrange
12 = Ch1Overrange
11 = Ch2Underrange
10 = Ch2Overrange
9 = Ch3Underrange
8 = Ch3Overrange
7 = Ch4Underrange
6 = Ch4Overrange
5 = Ch5Underrange
4 = Ch5Overrange


15 14 13 12 11 10 9 8
A calibrating fault sets bit 11 in the Module Fault word
Cold Junction temperature underrange and overrange conditions set bits 9 and 8 for 1756-IT6I only
Any bit in the Channel Fault word, also sets the Analog Group Fault and Input Group Fault in the Module Fault word
5 4 3 2 1 0
When the module is calibrating, all bits in the Channel Fault word are set.
15 14 13 12 11 10 9 8 7 6 5 4
Underrange and overrange conditions set the corresponding Channel Fault word bit for that channel.
41349

Module Fault Word Bits – Integer Mode

In integer mode, Module Fault word bits (bits 15…8) operate exactly as described in floating point mode. The table lists tags that are found in the Module Fault Word:

Module Fault Word Tags

Tag	Description
Analog Group Fault	This bit is set when any bits in the Channel Fault word are set. Its tag name is AnalogGroupFault.
Input Group Fault	This bit is set when any bits in the Channel Fault word are set. Its tag name is InputGroup.
Calibrating	This bit is set when any channel is being calibrated. When this bit is set, all bits in the Channel Fault word are set. Its tag name is Calibrating.
Calibration Fault	This bit is set when any of the individual Channel Calibration Fault bits are set. Its tag name is CalibrationFault.
Cold Junction Underrange – 1756-IT6I only	This bit is set when the ambient temperature around the cold junction sensor is below 0 ^{o}C. Its tag name is CJUnderrange.
Cold Junction Overrange – 1756-IT6I only	This bit is set when the ambient temperature around the cold junction sensor is above 86 ^{o}C. Its tag name is CJOverrange.

Channel Fault Word Bits – Integer Mode

In integer mode, Channel Fault word bits operate exactly as described in floating point mode. The table lists the conditions that set all Channel Fault word bits.

Channel Fault Word Conditions

This condition sets all Channel Fault word bits	And causes the module to display the following in the Channel Fault word bits
A channel is being calibrated.	"003F" for all bits.
A communication fault occurred between the module and its owner-controller.	"FFFF" for all bits.

Your logic can monitor the Channel Fault Word bit for a particular input to determine the state of that point.

Channel Status Word Bits – Integer Mode

The Channel Status word has the following differences when used in integer mode:

- Only Underrange and Overrange conditions are reported by the module.
- Alarming and Calibration Fault activities are not available, although the Calibration Fault bit in the Module Fault word will activate if a channel is not properly calibrated.
- There is only one Channel Status word for all six channels.

When the Calibration Fault bit (bit 7) is set in any of the words, the Calibration Fault bit (bit 9) is set in the Module Fault word. The table lists the conditions that set each of the words.

Channel Status Word Conditions

Tag (Status word)	Bit	Event that sets this tag
ChxUnderrange	Odd-numbered bits from bit 15…bit 5 (bit 15 represents channel 0). For a full listing of the channels these bits represent, see page 145.	The underrange bit is set when the input signal at the channel is less than or equal to the minimum detectable signal. For more information on the minimum detectable signal for each module, see page 123. This bit also sets the appropriate bit in the Channel Fault word.
ChxOverrange	Even-numbered bits from bit 14…bit 4 (bit 14 represents channel 0). For a full listing of the channels these bits represent, see page 145.	The overrange bit is set when the input signal at the channel is greater than or equal to the maximum detectable signal. For more information on the maximum detectable signal for each module, see page 123. This bit also sets the appropriate bit in the Channel Fault word.

Notes:

Non-isolated Analog Output Modules (1756-OF4 and 1756-OF8)

Introduction

This chapter describes features specific to ControlLogix non-isolated analog output modules.

Topic	Page
Choose a Data Format	150
Non-isolated Output Module Features	150
Use Module Block and Output Circuit Diagrams	154
Wire the 1756-OF4 Module	157
Wire the 1756-OF8 Module	158
1756-OF4 and 1756-OF8 Module Fault and Status Reporting	159

The non-isolated analog output modules also support features described in Chapter 3. See the table for some of these features.

Feature	Page
Removal and Insertion Under Power (RIUP)	36
Module Fault Reporting	36
Configurable Software	36
Electronic Keying	37
Access to System Clock for Timestamp Functions	44
Rolling Timestamp	44
Producer/Consumer Model	44
Status Indicator Information	45
Full Class I Division 2 Compliance	45
Agency Certification	45
Field Calibration	45
Sensor Offset	46
Latching of Alarms	46

Choose a Data Format

Data format defines the format of channel data sent from the controller to the module, defines the format of the 'data echo' that the module produces, and determines the features that are available to your application. You choose a data format when you choose a Communication Format.

You can choose one of these data formats:

- Integer mode
- Floating point mode

The table shows features that are available in each format.

Features Available in Each Data Format

Data Format	Features Available	Features Not Available
Integer mode	Ramp to program value	Clamping
	Ramp to fault value	Ramp in Run mode
	Hold for initialization	Rate and Limit alarms
	Hold Last State or User Value in fault or program mode	Scaling
Floating point mode	All features	N/A

For details on input and output data formats, see page 205 in Chapter 10.

Non-isolated Output Module Features

The table lists features that are specific to the non-isolated analog output modules.

Non-isolated Analog Output Module Features

Feature	Page
Ramping/Rate Limiting	151
Hold for Initialization	151
Open Wire Detection	152
Clamping/Limiting	152
Clamp/Limit Alarms	153
Data Echo	153

You can mix current and voltage outputs on a 1756-OF4 or 1756-OF8 module. Other common features are described in the following pages.

Ramping/Rate Limiting

Ramping limits the speed that an analog output signal can change. This prevents fast transitions in the output from damaging the devices that an output module controls. Ramping is also known as rate limiting.

Types of Ramping

Ramping Type	Description
Run mode ramping	This type of ramping occurs when the module is in Run mode and begins operation at the configured maximum ramp rate when the module receives a new output level. **IMPORTANT**: This is only available in floating point mode.
Ramp to Program mode	This type of ramping occurs when the present output value changes to the Program value after a Program command is received from the controller.
Ramp to fault mode	This type of ramping occurs when the present output value changes to the Fault value after a communication fault occurs.

The maximum rate of change in outputs is expressed in engineering units per second and called the maximum ramp rate.

See page 223 for how to enable Run mode ramping and set the maximum ramp rate.

Hold for Initialization

Hold for Initialization causes outputs to hold present state until the value commanded by the controller matches the value at the output screw terminal within 0.1% of full scale, providing a bumpless transfer.

If Hold for Initialization is selected, outputs hold if there is an occurrence of any of these three conditions.

- Initial connection is established after power-up.
- A new connection is established after a communications fault occurs.
- There is a transition to Run mode from Program state.

The InHold bit for a channel indicates that the channel is holding.

To see how to enable the Hold for Initialization bit, see page 220.

Open Wire Detection

This feature detects when current flow is not present at any channel. The 1756-OF4 and 1756-OF8 modules must be configured for 0…20 mA operation to use this feature. At least 0.1 mA of current must be flowing from the output for detection to occur.

When an open wire condition occurs at any channel, a status bit is set for that channel.

For more information on the use of status bits, see page 159.

Clamping/Limiting

Clamping limits the output from the analog module to remain within a range configured by the controller, even when the controller commands an output outside that range. This safety feature sets a high clamp and a low clamp.

Once clamps are determined for a module, any data received from the controller that exceeds those clamps sets an appropriate limit alarm and transitions the output to that limit but not beyond the requested value.

For example, an application may set the high clamp on a module for 8V and the low clamp for -8V. If a controller sends a value corresponding to 9V to the module, the module will only apply 8V to its screw terminals.

Clamping alarms can be disabled or latched on a per channel basis.

IMPORTANT

Clamping is only available in floating point mode.

Clamp values are in engineering scaling units and are not automatically updated when the engineering high and low scaling units are changed. Failure to update the clamp values may generate a very small output signal that could be misinterpreted as a hardware problem.

To see how to set the clamping limits, see page 223.

Clamp/Limit Alarms

This function works directly with clamping. When a module receives a data value from the controller that exceeds clamping limits, it applies signal values to the clamping limit but also sends a status bit to the controller notifying it that the value sent exceeds the clamping limits.

Using the example above, if a module has clamping limits of 8V and -8V but then receives data to apply 9V, only 8V is applied to the screw terminals and the module sends a status bit back to the controller informing it that the 9V value exceeds the module's clamping limits.

IMPORTANT Limit alarms are available only in floating point mode.

To see how to enable all alarms, see page 223.

Data Echo

Data Echo automatically multicasts channel data values that match the analog value that was sent to the module's screw terminals at that time.

Fault and status data is also sent. This data is sent in the format (floating point or integer) selected at the requested packet interval (RPI).

User Count Conversion to Output Signal

User counts can be computed in Integer mode for the 1756-OF4 and 1756-OF8 modules.

The straight line formulas that can be used to calculate or program a Compute (CPT) instruction are shown in the table.

Available Range	User Count Formula
0…20 mA	y = 3077.9744124443446x-32768 where y = counts; x = mA
+/-10V	y = 3140.5746817972704x-0.5 where y = counts; x = V

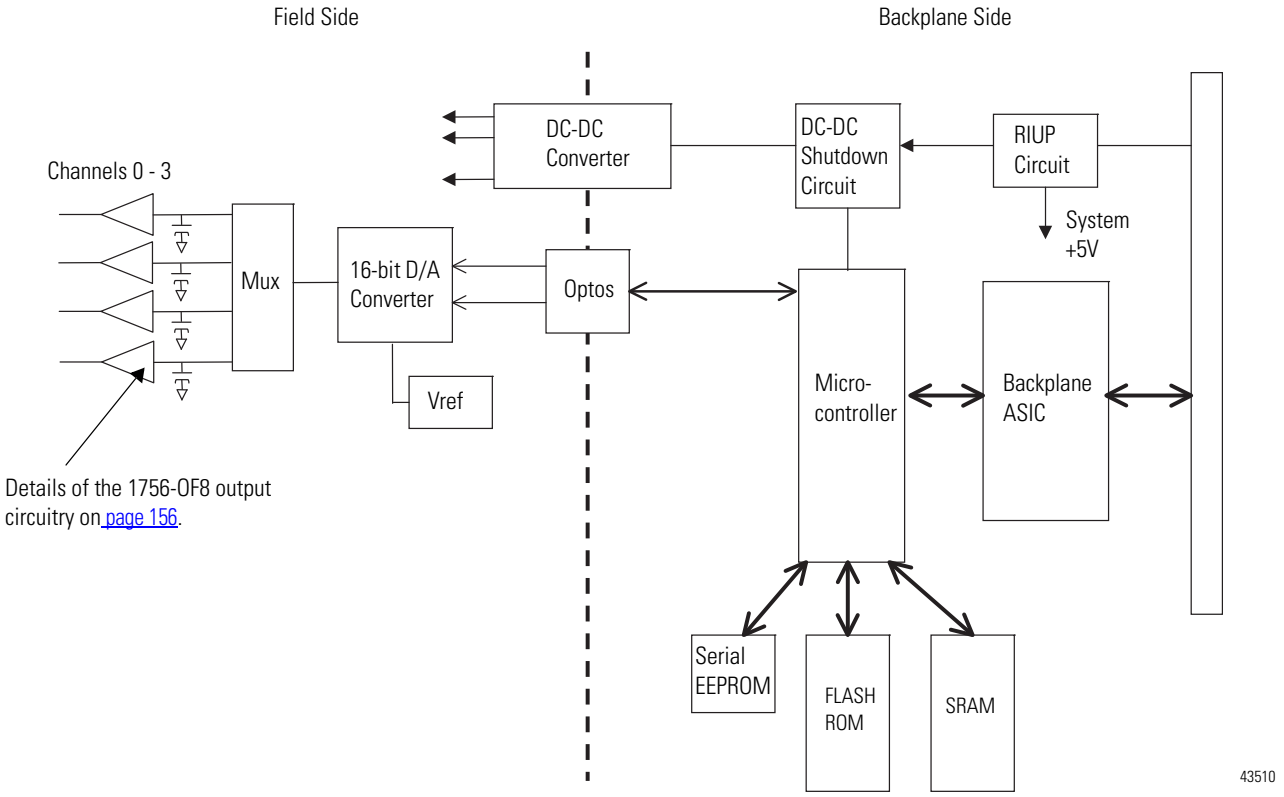
For example, if you have 6 mA in the 0…20 mV range, the user counts = -14300. Counts = 6281 for 2 V in the +/-10V range.

For a table with related values, refer to ControlLogix 1756-OF4 and 1756-OF8 User Count Conversion to Output Signal, Knowledgebase Technical Note ID 41570.

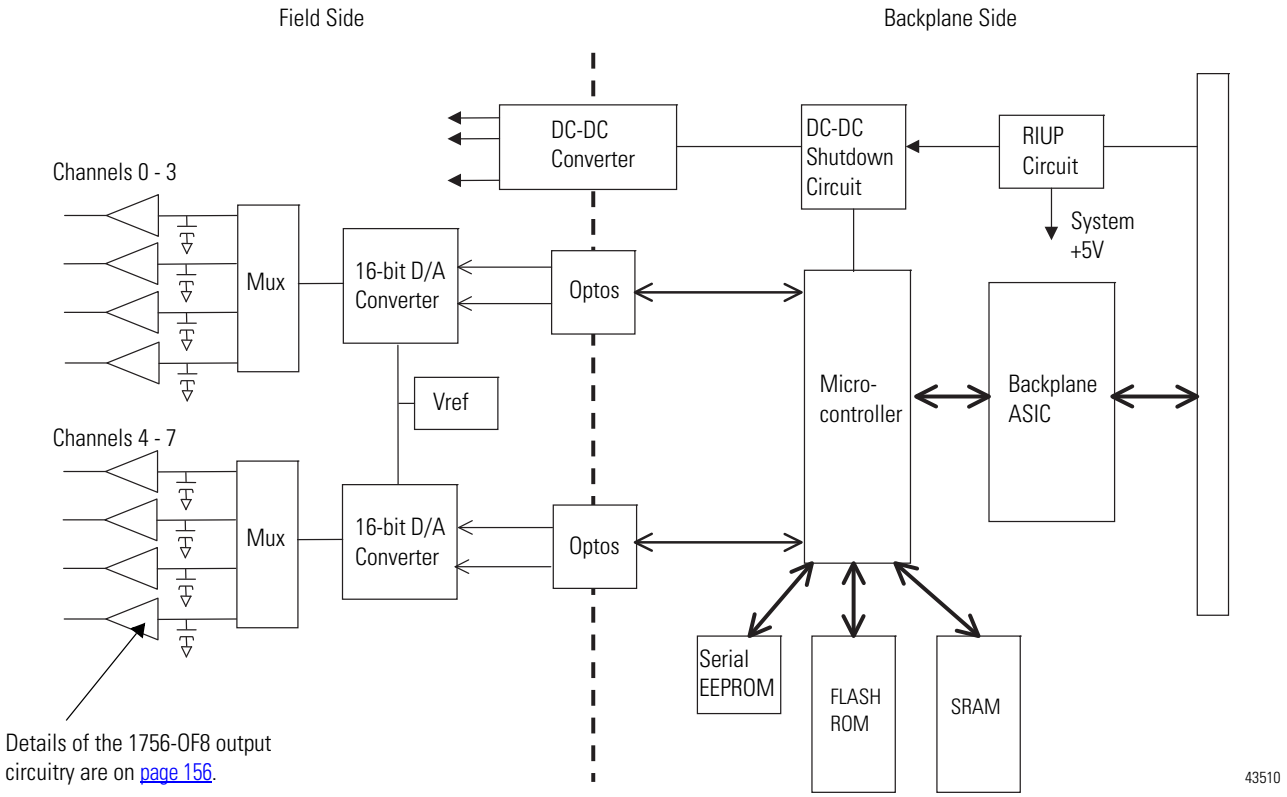
Use Module Block and Output Circuit Diagrams

This section shows the 1756-OF4 and 1756-OF8 modules' block diagrams and output circuit diagrams.

1756-OF4 Module Block Diagram



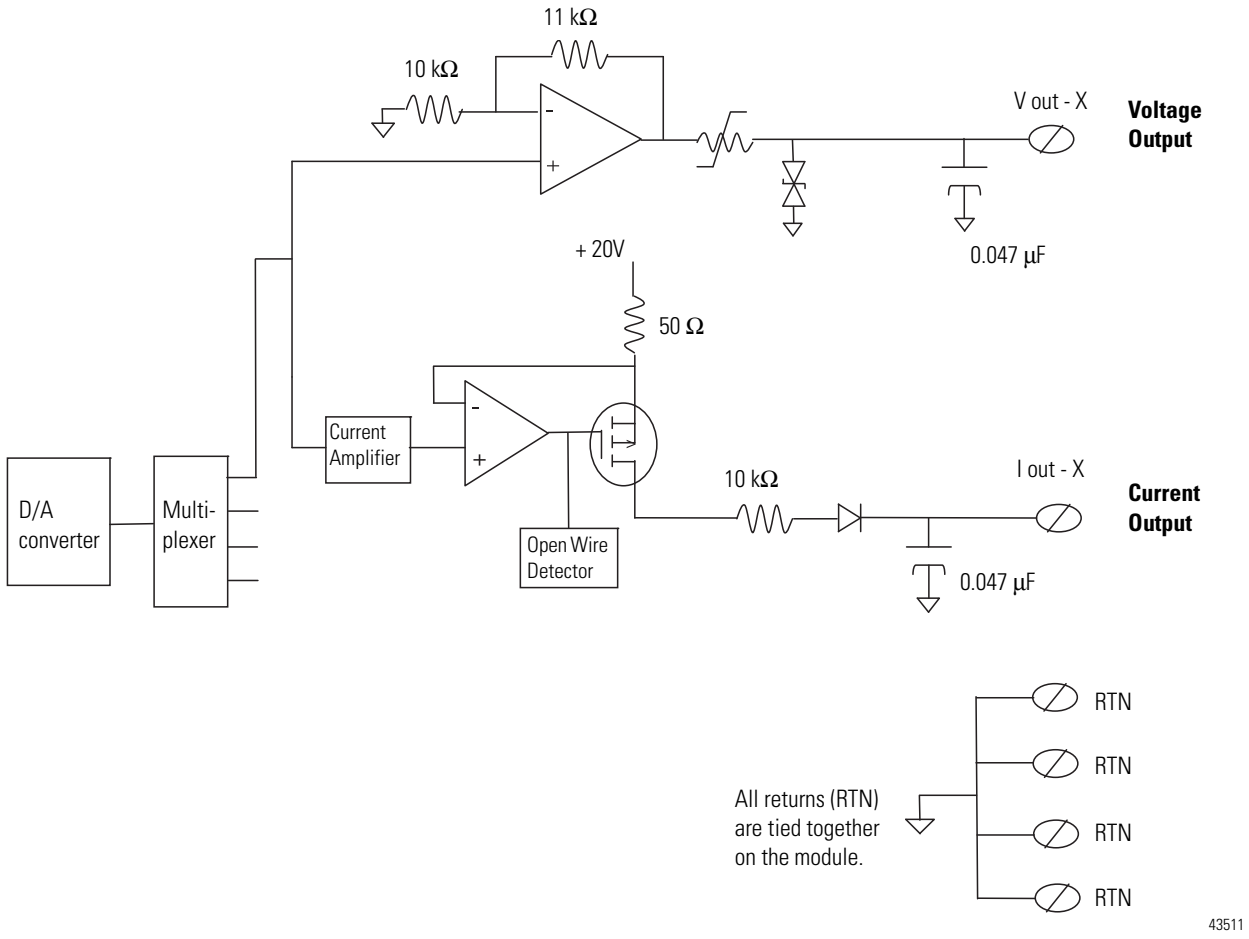
1756-OF8 Module Block Diagram



Field-side Circuit Diagrams

The diagrams show field-side circuitry for the 1756-OF4 and 1756-OF8 modules.

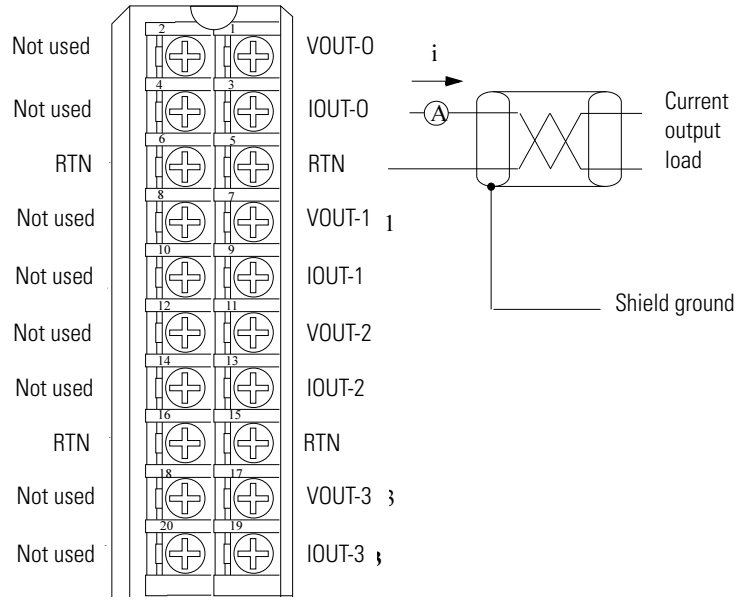
1756-OF4 and 1756-OF8 Output Circuit



Wire the 1756-OF4 Module

The illustration shows wiring examples for the 1756-OF4 module.

1756-OF4 Current wiring example



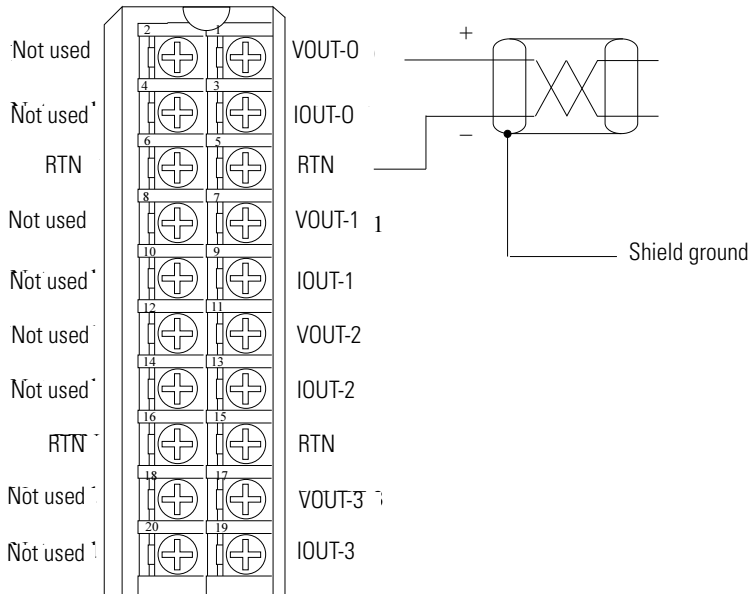
NOTES:

1. Place additional loop devices (that is, strip chart recorders, and so forth) at the A location noted above.
2. Do not connect more than two wires to any single terminal.

40916-M

3. All terminals marked RTN are connected internally.

1756-OF4 Voltage wiring example



NOTES:

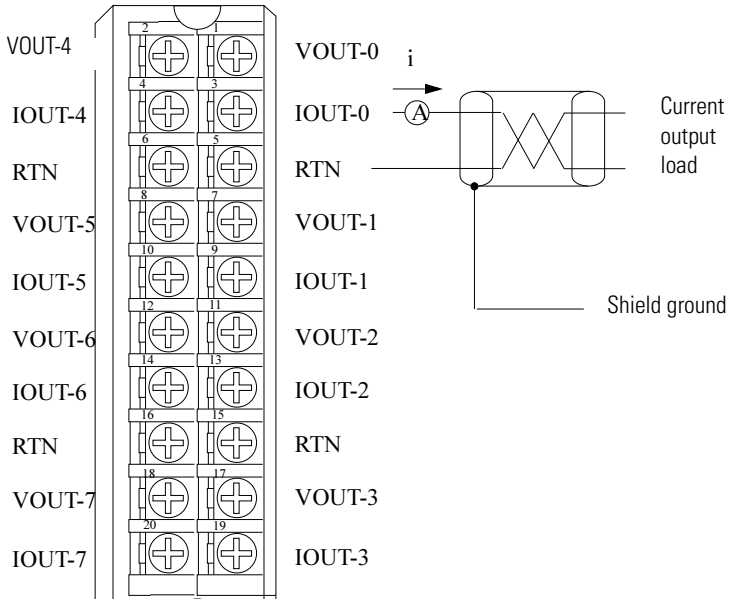
1. Do not connect more than two wires to any single terminal.
2. All terminals marked RTN are connected internally.

40912-M

Wire the 1756-OF8 Module

The illustration shows wiring examples for the 1756-OF8 module.

1756-OF8 Current wiring example



NOTES:

1. Place additional loop devices (that is, strip chart recorders, and so forth) at the A location noted above.
2. Do not connect more than two wires to any single terminal.
3. All terminals marked RTN are connected internally.

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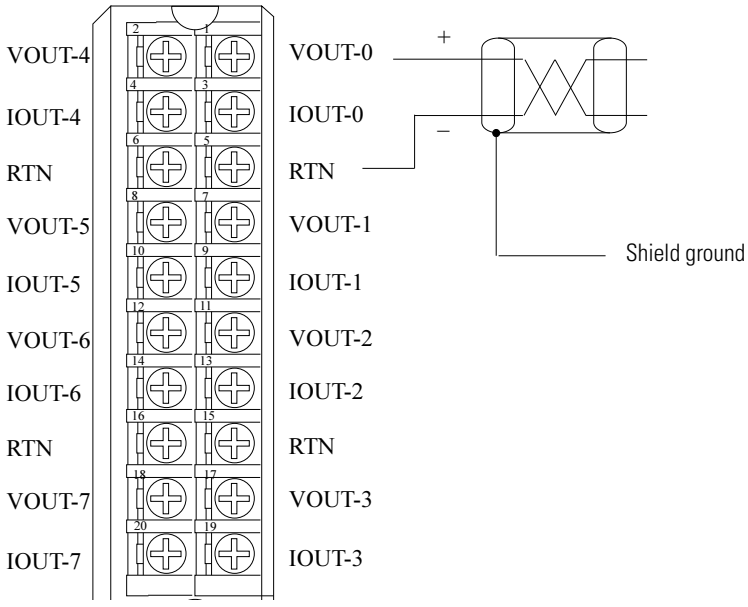
1756-OF8 Voltage wiring example



NOTES:

1. Do not connect more than two wires to any single terminal.
2. All terminals marked RTN are connected internally.

40917-M

1756-OF4 and 1756-OF8 Module Fault and Status Reporting

The 1756-OF4 and 1756-OF8 modules multicast status and fault data to the owner-listening controller with their channel data. The fault data is arranged in such a manner as to let you choose the level of granularity for examining fault conditions.

Three levels of tags work together to provide increasing degree of detail as to the specific cause of faults on the module.

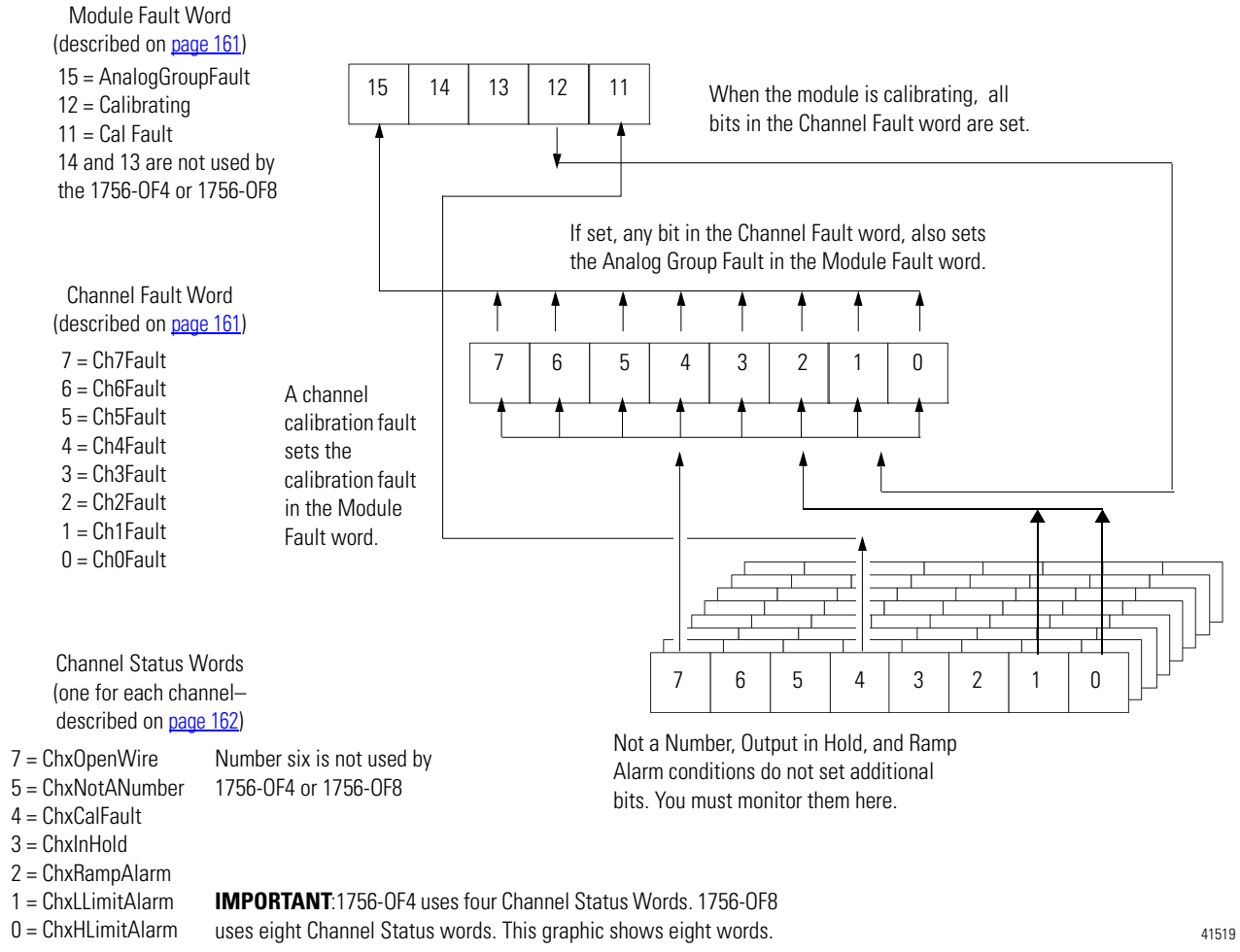
The table lists tags that can be examined in ladder logic to indicate when a fault occurs.

Tag	Description
Module Fault Word	This word provides fault summary reporting. Its tag name is ModuleFaults.
Channel Fault Word	This word provides underrange, overrange and communications fault reporting. Its tag name is ChannelFaults.
Channel Status Words	This word provides individual channel underrange and overrange fault reporting for process alarms, rate alarms and calibration faults. Its tag name is ChxStatus.

IMPORTANT Differences exist between floating point and integer modes as they relate to module fault reporting. These differences are explained in the following two sections.

1756-OF4 and 1756-OF8 Fault Reporting in Floating Point Mode

The illustration offers an overview of the fault reporting process in floating point mode.


Module Fault Word
(described on page 161)
15 = AnalogGroupFault
12 = Calibrating
11 = Cal Fault
14 and 13 are not used by
the 1756-OF4 or 1756-OF8
15 14 13 12 11
When the module is calibrating, all
bits in the Channel Fault word are set.
If set, any bit in the Channel Fault word, also sets
the Analog Group Fault in the Module Fault word.
Channel Fault Word
(described on page 161)
7 = Ch7Fault
6 = Ch6Fault
5 = Ch5Fault
4 = Ch4Fault
3 = Ch3Fault
2 = Ch2Fault
1 = Ch1Fault
0 = Ch0Fault
7 6 5 4 3 2 1 0
A channel
calibration fault
sets the
calibration fault
in the Module
Fault word.
Channel Status Words
(one for each channel–
described on page 162)
7 = ChxOpenWire
5 = ChxNotANumber
4 = ChxCalFault
3 = ChxInHold
2 = ChxRampAlarm
1 = ChxLLimitAlarm
0 = ChxHLimitAlarm
7 6 5 4 3 2 1 0
Number six is not used by
1756-OF4 or 1756-OF8
Not a Number, Output in Hold, and Ramp
Alarm conditions do not set additional
bits. You must monitor them here.
41519

IMPORTANT:1756-OF4 uses four Channel Status Words. 1756-OF8 uses eight Channel Status words. This graphic shows eight words.

Module Fault Word Bits – Floating Point Mode

Bits in this word provide the highest level of fault detection. A nonzero condition in this word reveals that a fault exists on the module. You can examine further down to isolate the fault.

The table lists tags that are found in the Module Fault Word.

Tag	Description
Analog Group Fault	This bit is set when any bits in the Channel Fault word are set. Its tag name is AnalogGroupFault.
Calibrating	This bit is set when any channel is being calibrated. When this bit is set, all bits in the Channel Fault word are set. Its tag name is Calibrating.
Calibration Fault	This bit is set when any of the individual Channel Calibration Fault bits are set. Its tag name is CalibrationFault.

Channel Fault Word Bits – Floating Point Mode

During normal module operation, Channel Fault word bits are set if any of the respective channels has a High or Low Limit Alarm or an Open Wire condition (0…20 mA configuration only). When using the Channel Fault Word, the 1756-OF4 module uses bits 0…3, and the 1756-OF8 uses bits 0…7. Checking this word for a nonzero condition is a quick way to check for these conditions on a channel.

The table lists the conditions that set **all** Channel Fault word bits.

This condition sets all Channel Fault word bits	And causes the module to display the following in the Channel Fault word bits
A channel is being calibrated	'000F' for all bits on the 1756-OF4 module '00FF' for all bits on the 1756-OF8 module
A communications fault occurred between the module and its owner-controller	'FFFF' for all bits on either module

Your logic should monitor the Channel Fault bit for a particular output, if you either:

- enable output clamping.
- are checking for a open wire condition (0 …20 mA configuration only).

Channel Status Words Bits – Floating Point Mode

Any of the Channel Status words (four words for 1756-OF4 and eight words for 1756-OF8), one for each channel, will display a nonzero condition if that particular channel has faulted for the conditions listed below. Some of these bits set bits in other Fault words.

When the High or Low Limit Alarm bits (bits 1 and 0) in any of the words are set, the appropriate bit is set in the Channel Fault word.

When the Calibration Fault bit (bit 4) is set in any of the words, the Calibration Fault bit (bit 11) is set in the Module Fault word.

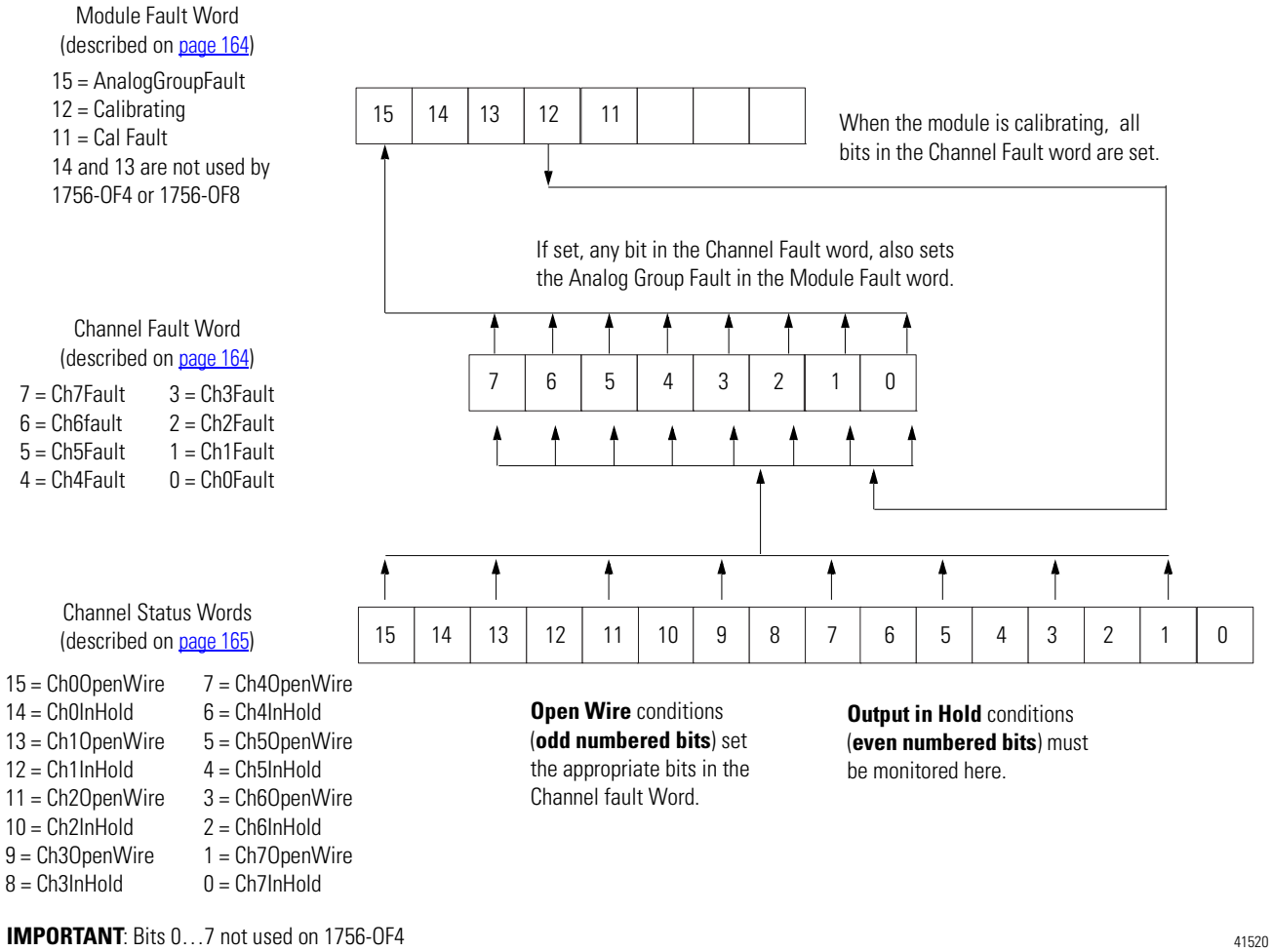
The table lists the conditions that set each of the word bits.

Tag (Status word)	Bit	Event that sets this tag
ChxOpenWire	Bit 7	This bit is set only if the configured Output Range is 0…20 mA, and the circuit becomes open due to a wire falling or being cut when the output being driven is above 0.1 mA. The bit will remain set until correct wiring is restored.
ChxNotaNumber	Bit 5	This bit is set when the output value received from the controller is NotANumber (the IEEE NAN value). The output channel will hold its last state.
ChxCalFault	Bit 4	This bit is set when an error occurred when calibrating. This bit also sets the appropriate bit in the Channel Fault word.
ChxInHold	Blt 3	This bit is set when the output channel is currently holding. The bit resets when the requested Run mode output value is within 0.1% of full-scale of the current echo value.
ChxRampAlarm	Bit 2	This bit is set when the output channel's requested rate of change would exceed the configured maximum ramp rate requested parameter. It remains set until the output reaches its target value and ramping stops. If the bit is latched, it will remain set until it is unlatched.
ChxLLimitAlarm	Bit 1	This bit is set when the requested output value is beneath the configured low limit value. It remains set until the requested output is above the low limit. If the bit is latched, it will remain set until it is unlatched.
ChxHLimitAlarm	Bit 0	This bit is set when the requested output value is above the configured high limit value. It remains set until the requested output is below the high limit. If the bit is latched, it will remain set until it is unlatched.

IMPORTANT Notice that the 1756-OF4 and 1756-OF8 modules do not use **bit 6**.

1756-OF4 and 1756-OF8 Fault Reporting in Integer Mode

The illustration provides an overview of the fault reporting process in integer mode.


Module Fault Word
(described on page 164)
15 = AnalogGroupFault
12 = Calibrating
11 = Cal Fault
14 and 13 are not used by
1756-OF4 or 1756-OF8
15 14 13 12 11
When the module is calibrating, all bits in the Channel Fault word are set.
If set, any bit in the Channel Fault word, also sets the Analog Group Fault in the Module Fault word.
Channel Fault Word
(described on page 164)
7 = Ch7Fault
6 = Ch6fault
5 = Ch5Fault
4 = Ch4Fault
3 = Ch3Fault
2 = Ch2Fault
1 = Ch1Fault
0 = Ch0Fault
7 6 5 4 3 2 1 0
Channel Status Words
(described on page 165)
15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
15 = Ch0OpenWire
14 = Ch0InHold
13 = Ch1OpenWire
12 = Ch1InHold
11 = Ch2OpenWire
10 = Ch2InHold
9 = Ch3OpenWire
8 = Ch3InHold
7 = Ch4OpenWire
6 = Ch4InHold
5 = Ch5OpenWire
4 = Ch5InHold
3 = Ch6OpenWire
2 = Ch6InHold
1 = Ch7OpenWire
0 = Ch7InHold
Open Wire conditions (**odd numbered bits**) set the appropriate bits in the Channel fault Word.
Output in Hold conditions (**even numbered bits**) must be monitored here.
41520

IMPORTANT: Bits 0…7 not used on 1756-OF4

Module Fault Word Bits – Integer Mode

In integer mode, Module Fault word bits (bits 15…11) operate exactly as described in floating point mode. The table lists tags that are found in the Module Fault Word.

Tag	Description
Analog Group Fault	This bit is set when any bits in the Channel Fault word are set. Its tag name is AnalogGroupFault.
Calibrating	This bit is set when any channel is being calibrated. When this bit is set, all bits in the Channel Fault word are set. Its tag name is Calibrating.
Calibration Fault	This bit is set when any of the individual Channel Calibration Fault bits are set. Its tag name is CalibrationFault.

Channel Fault Word Bits – Integer Mode

In integer mode, Channel Fault word bits (bits 7…0) operate exactly as described in floating point mode for calibration and communications faults. During normal operation, these bits are only set for an open wire condition. The table lists the conditions that set **all** Channel Fault word bits.

This condition sets all Channel Fault word bits	And causes the module to display the following in the Channel Fault word bits
A channel is being calibrated	'000F' for all bits on the 1756-OF4 module '00FF' for all bits on the 1756-OF8 module
A communications fault occurred between the module and its owner-controller	'FFFF' for all bits on either module

Your logic should monitor the Channel Fault bit for a particular output, if you either:

- enable output clamping.
- are checking for a open wire condition (0 …20 mA configuration only).

Channel Status Word Bits – Integer Mode

The Channel Status word has these differences when used in integer mode.

- Only the Output in Hold and Open Wire conditions are reported by the module.
- Calibration Fault reporting is not available in this word, although the Calibration Fault bit in the Module Fault word will still activate when that condition exists on any channel.
- There is only one Channel Status word for all four channels on 1756-OF4 and all eight channels on 1756-OF8.

The table lists the conditions that set each of the Status Word bits.

Tag (Status word)	Bit	Event that sets this tag
ChxOpenWire	Odd-numbered bits from bit 15 …bit 1 (that is, bit 15 represents channel 0). For a full listing of the channels these bits represent, see page 163.	The Open Wire bit is set only if the configured Output Range is 0 …20 mA, and the circuit becomes open due to a wire falling or being cut when the output being driven is above 0.1mA. The bit will remain set until correct wiring is restored.
ChxInHold	Even-numbered bits from bit 14…bit 0 (that is, bit 14 represents channel 0). For a full listing of the channels these bits represent, see page 163.	The Output In Hold bit is set when the output channel is currently holding. The bit resets when the requested Run mode output value is within 0.1% of full-scale of the current echo value.

Notes:

Isolated Analog Output Modules (1756-OF6CI and 1756-OF6VI)

Introduction

This chapter describes features specific to ControlLogix isolated analog output modules that provide a high level of noise immunity. The 'C' and 'V' in the respective catalog numbers indicate 'current' and 'voltage'.

Topic	Page
Choose a Data Format	168
Ramping/Rate Limiting	169
Use Module Block and Output Circuit Diagrams	172
Drive Different Loads with the 1756-OF6CI	174
Wire the 1756-OF6CI Module	177
Wire the 1756-OF6VI Module	178
1756-OF6CI and 1756-OF6VI Module Fault and Status Reporting	179

The isolated analog output modules also support features described in Chapter 3. See the table for some of these features.

Feature	Page
Removal and Insertion Under Power (RIUP)	36
Module Fault Reporting	36
Configurable Software	36
Electronic Keying	37
Access to System Clock for Timestamp Functions	44
Rolling Timestamp	44
Producer/Consumer Model	44
Status Indicator Information	45
Full Class I Division 2 Compliance	45
Agency Certification	45
Field Calibration	45
Sensor Offset	46
Latching of Alarms	46

Choose a Data Format

Data format defines the format of channel data sent from the controller to the module, defines the format of the 'data echo' that the module produces, and determines the features that are available to your application. You choose a data format when you choose a Communication Format.

You can choose one of these data formats:

- Integer mode
- Floating point mode

The table shows features that are available in each format.

Features Available in Each Data Format

Data Format	Features Available	Features Not Available
Integer mode	Ramp to program value	Clamping
	Ramp to fault value	Ramp in Run mode
	Hold for initialization	Rate and Limit alarms
	Hold Last State or User Value in fault or program mode	Scaling
Floating point mode	All features	N/A

For details on input and output data formats, see page 205 in Chapter 10.

Isolated Output Module Features

The table lists features that are specific to the isolated analog output modules.

Isolated Analog Output Module Features

Feature	Page
Ramping/Rate Limiting	169
Hold for Initialization	169
Clamping/Limiting	170
Clamp/Limit Alarms	170
Data Echo	171

Ramping/Rate Limiting

Ramping limits the speed at which an analog output signal can change. This prevents fast transitions in the output from damaging the devices that an output module controls. Ramping is also known as rate limiting.

The table describes the types of ramping that are possible.

Ramping type	Description
Run mode ramping	This type of ramping occurs when the module is in Run mode and begins operation at the configured maximum ramp rate when the module receives a new output level. **IMPORTANT**: This is only available in floating point mode.
Ramp to Program mode	This type of ramping occurs when the present output value changes to the Program value after a Program command is received from the controller.
Ramp to Fault mode	This type of ramping occurs when the present output value changes to the Fault value after a communications fault occurs.

The maximum rate of change in outputs is expressed in engineering units per second and called the maximum ramp rate.

See page 223 for how to enable Run mode ramping and set the maximum ramp rate.

Hold for Initialization

Hold for Initialization causes outputs to hold present state until the value commanded by the controller matches the value at the output screw terminal within 0.1% of full scale, providing a bumpless transfer.

If Hold for Initialization is selected, outputs hold if there is an occurrence of any of these three conditions.

- Initial connection is established after power-up.
- A new connection is established after a communications fault occurs.
- There is a transition to Run mode from Program state.

The InHold bit for a channel indicates that the channel is holding.

To see how to enable the Hold for Initialization bit, see page 220.

Clamping/Limiting

Clamping limits the output from the analog module to remain within a range configured by the controller, even when the controller commands an output outside that range. This safety feature sets a high clamp and a low clamp.

Once clamps are determined for a module, any data received from the controller that exceeds those clamps sets an appropriate limit alarm and transitions the output to that limit but not beyond the requested value.

For example, an application may set the high clamp on a module for 8V and the low clamp for -8V. If a controller sends a value corresponding to 9V to the module, the module will only apply 8V to its screw terminals.

Clamping alarms can be disabled or latched on a per channel basis.

IMPORTANT

Clamping is only available in floating point mode.

Clamp values are in engineering scaling units and are not automatically updated when the engineering high and low scaling units are changed. Failure to update the clamp values may generate a very small output signal that could be misinterpreted as a hardware problem.

To see how to set the clamping limits, see page 223.

Clamp/Limit Alarms

This function works directly with clamping. When a module receives a data value from the controller that exceeds clamping limits, it applies signal values to the clamping limit but also sends a status bit to the controller notifying it that the value sent exceeds the clamping limits.

Using the example above, if a module has clamping limits of 8V and -8V but then receives data to apply 9V, only 8V is applied to the screw terminals and the module sends a status bit back to the controller informing it that the 9V value exceeds the module's clamping limits.

IMPORTANT

Limit alarms are available only in floating point mode.

To see how to enable all alarms, see page 223.

Data Echo

Data Echo automatically multicasts channel data values which match the analog value that was sent to the module's screw terminals at that time.

Fault and status data also is sent. This data is sent in the format (floating point or integer) selected at the requested packet interval (RPI).

User Count Conversion to Output Signal

User counts can be computed in Integer mode for the 1756-OF6CI and 1756-OF6VI modules.

The straight line formulas that can be used to calculate or program a Compute (CPT) instruction are shown in the table.

Available Range	User Count Formula
0…20 mA	y = 3109.7560975609754x-32768 where y = counts; x = mA
+/-10V	y = 3115.669867833032x-0.5 where y = counts; x = V

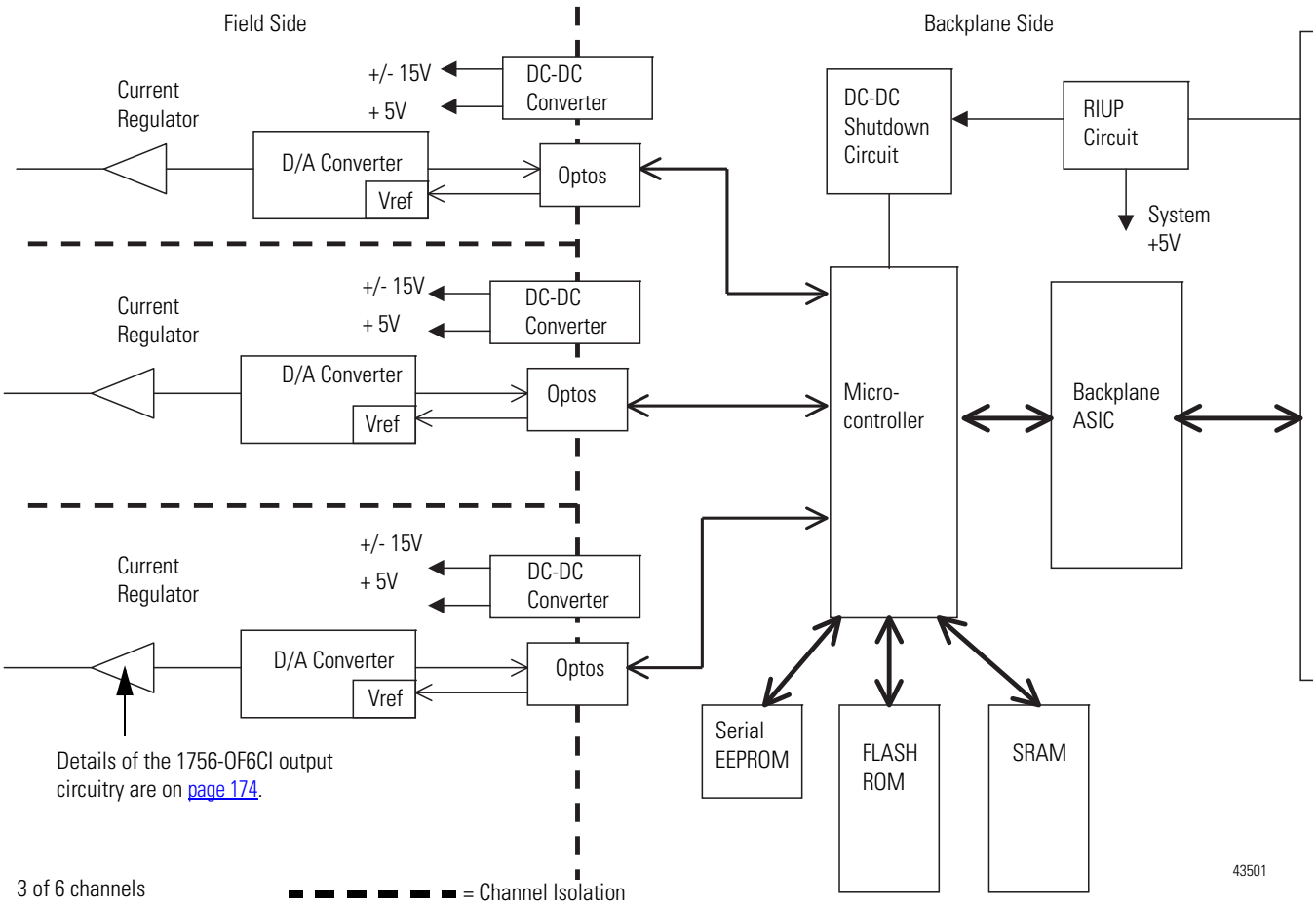
For example, if you have 3.5 mA in the 0…20 mV range, the user counts = -21884. Counts = 6231 for 2 V in the +/-10V range.

For a table with related values, refer to ControlLogix 1756-OF6CI and OF6VI User Count Conversion to Output Signal, Knowledgebase Technical Note IDs 41574 and 41576.

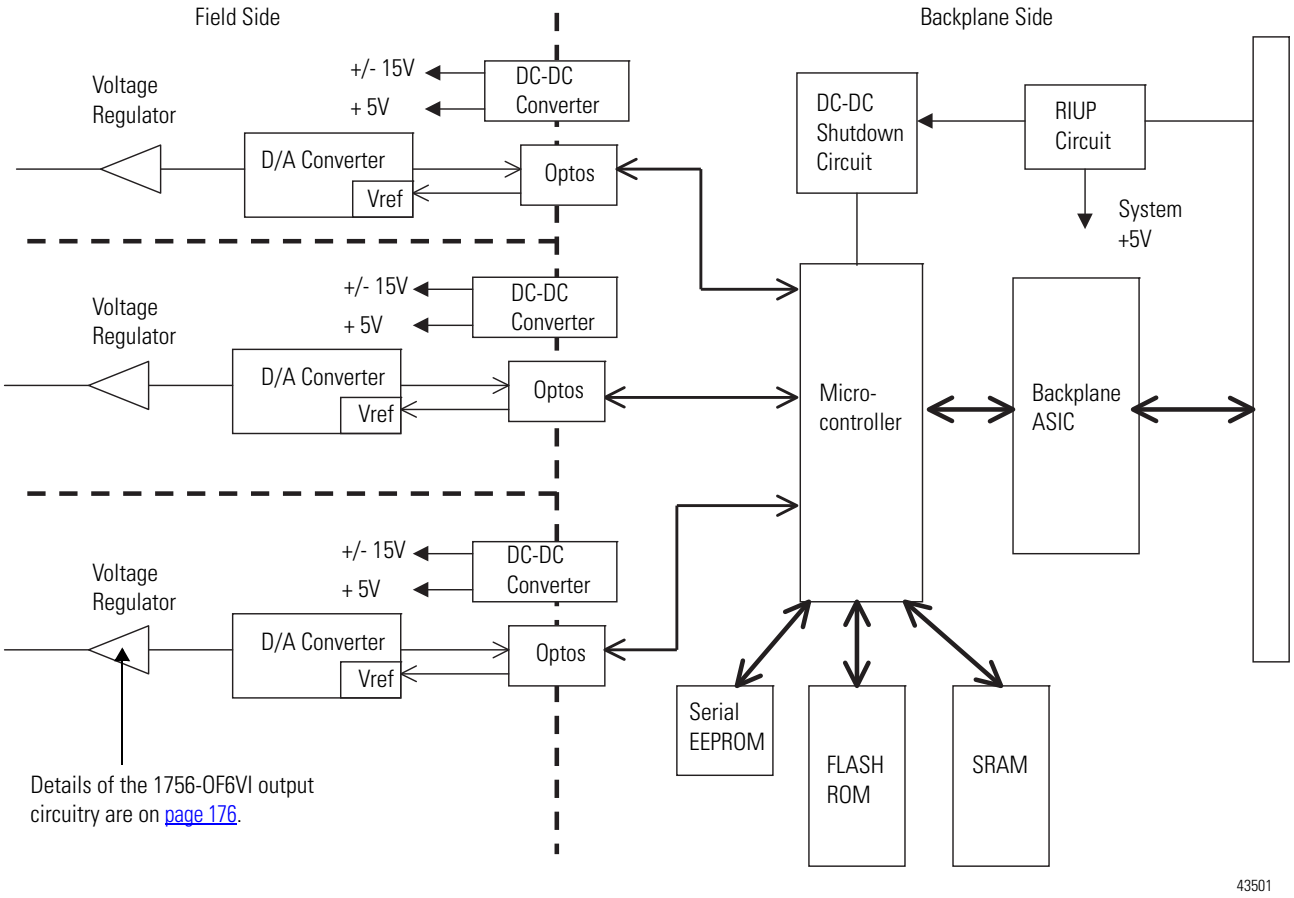
Use Module Block and Output Circuit Diagrams

This section shows the 1756-OF6CI and 1756-OF6VI modules' block diagrams and output circuit diagrams.

1756-OF6CI Module Block Diagram



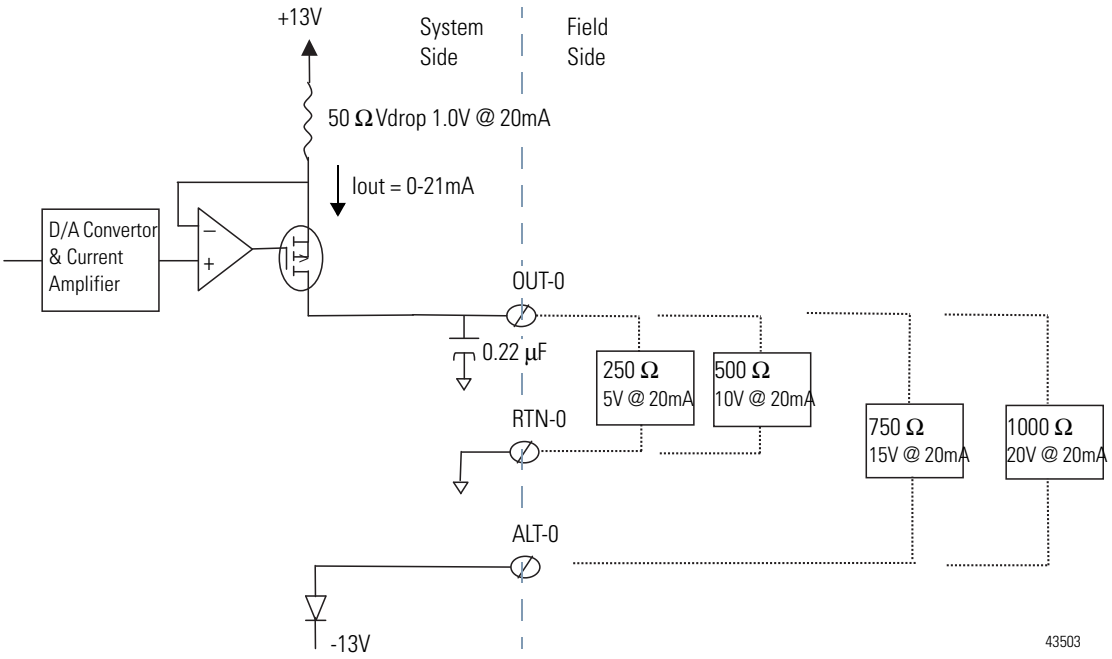
1756-OF6VI Module Block Diagram



Field-side Circuit Diagrams

The diagram shows field-side circuitry for the 1756-OF6CI module.

1756-OF6CI Output Circuit



Drive Different Loads with the 1756-OF6CI

The 1756-OF6CI module's output stage provides a constant current that flows through its internal electronics and out through the external output load. Since the output current is constant, the only variable in the current loop is the voltage across the output electronics and the voltage across the load. For a given termination option, the sum of the individual voltage drops around the loop components must add up to the total available voltage (13V for OUT-x/RTN-x termination and 26V for OUT-x / ALT-x).

As seen in the above diagram, a larger external output load will drop a larger portion of the available loop voltage, allowing the module to drop less volts across its internal output electronics. This lower drop allows the power dissipation in the module to be lower, minimizing the thermal affect to adjacent modules in the same chassis.

For loads under 550 Ω, the module's +13V internal voltage source can supply voltage for currents up to 21 mA. For loads over 550 Ω, additional compliance voltage is required. In this case, you must use the ALT terminal to provide the additional -13V source.

For any size load (that is, 0…1000 Ω), the output channels function if terminated between OUT-x and ALT-x. To improve module reliability and product life, we recommend you:

- Terminate the output channels between the OUT-x and RTN-x terminals for loads of 0…550 Ω
- Terminate the output channels between the OUT-x and ALT-x terminals for loads of 551…1000 Ω

IMPORTANT

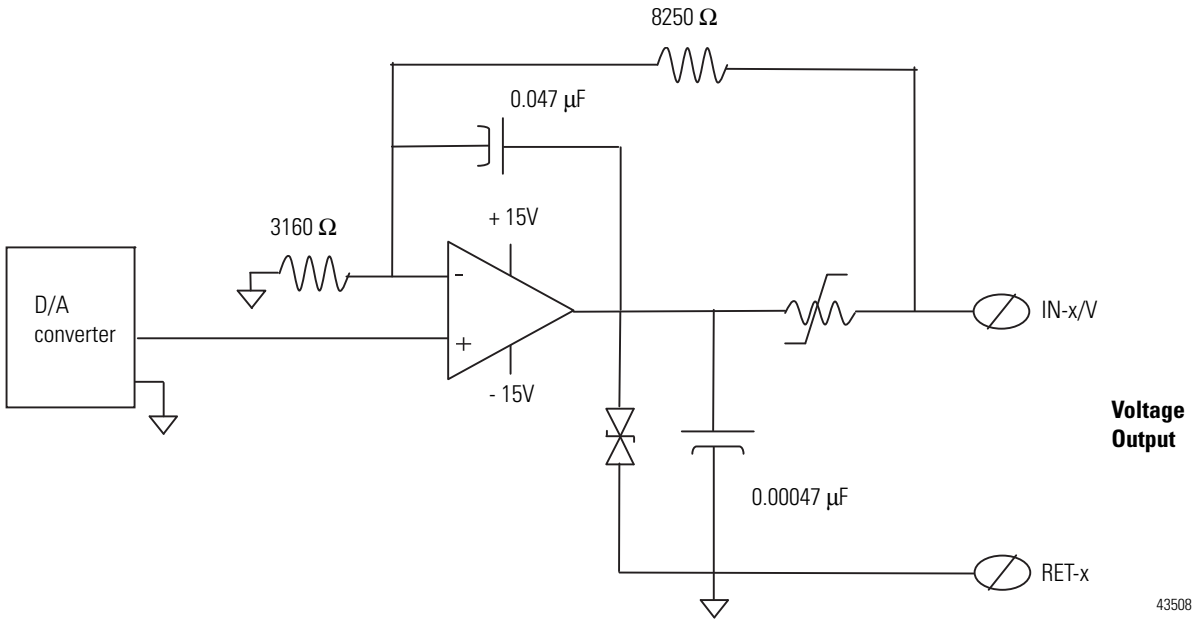
If you are unsure of the load, you can terminate the output channels between OUT-x and ALT-x and the module will operate but reliability may be compromised at elevated temperatures.

For example, if you terminate the output channels between OUT-x and ALT-x and use a 250 Ω load, the module operates but the lower load results in higher operating temperatures and may affect the module's reliability over time.

We recommend you terminate the output channels as described above whenever possible.

1756-OF6VI Output Circuit

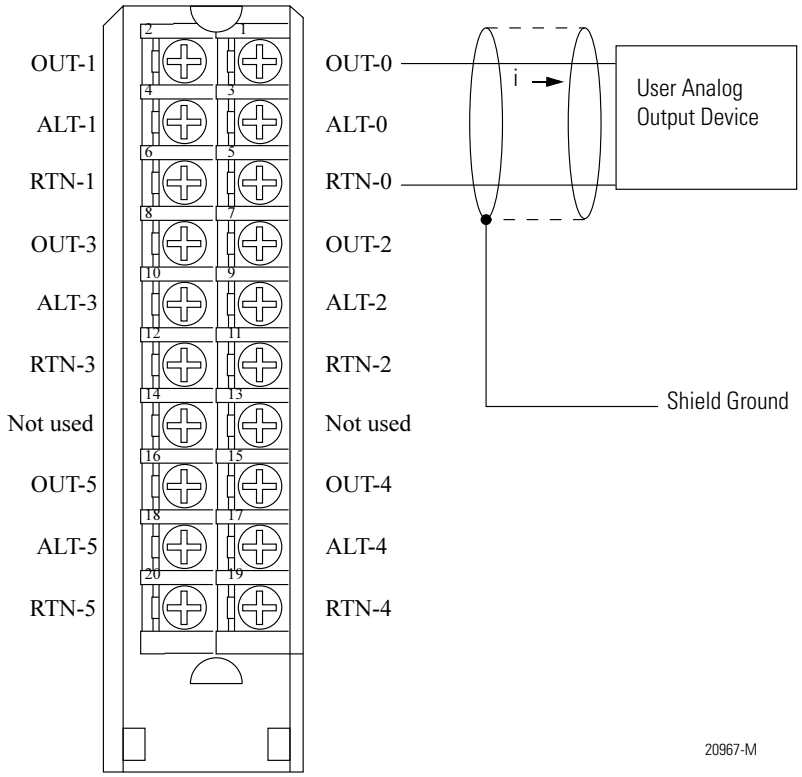
The diagram shows field-side circuitry for the 1756-OF6CI module.



Wire the 1756-OF6CI Module

The illustration shows wiring examples for the 1756-OF6CI module.

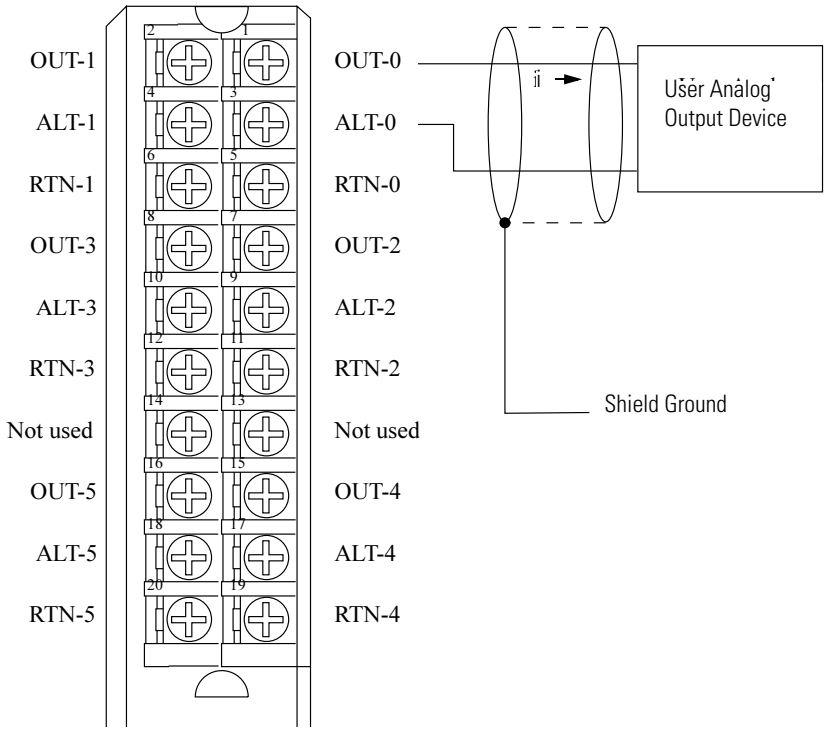
1756-OF6CI Wiring Example for Loads of 0-550 Ω



NOTES:

1. Place additional devices anywhere in the loop.
2. Do not connect more than two wires to any single terminal.

1756-OF6CI Wiring Example for Loads of 551-1000Ω



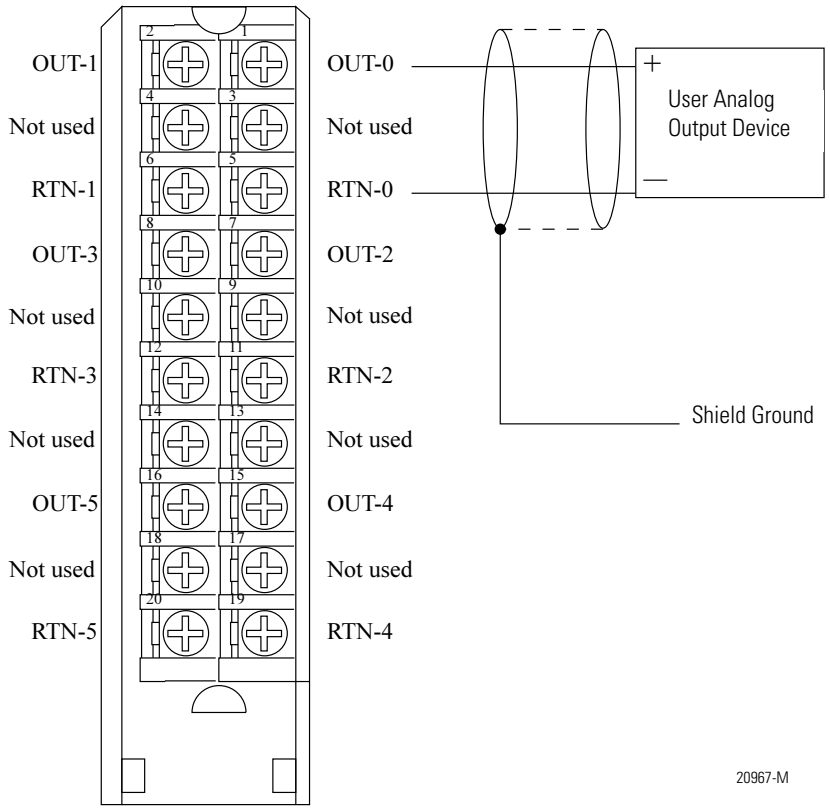
NOTES:

1. Place additional devices anywhere in the loop.
2. Do not connect more than two wires to any single terminal.

Wire the 1756-OF6VI Module

The illustration shows wiring examples for the 1756-OF6VI module.

1756-OF6VI Wiring example



NOTES:

1. Place additional devices anywhere in the loop.
2. Do not connect more than two wires to any single terminal.

1756-OF6CI and 1756-OF6VI Module Fault and Status Reporting

The 1756-OF6CI and 1756-OF6VI modules multicast status and fault data to the owner-listening controller with their channel data. The fault data is arranged in such a manner as to let you choose the level of granularity for examining fault conditions.

Three levels of tags work together to provide increasing degree of detail as to the specific cause of faults on the module.

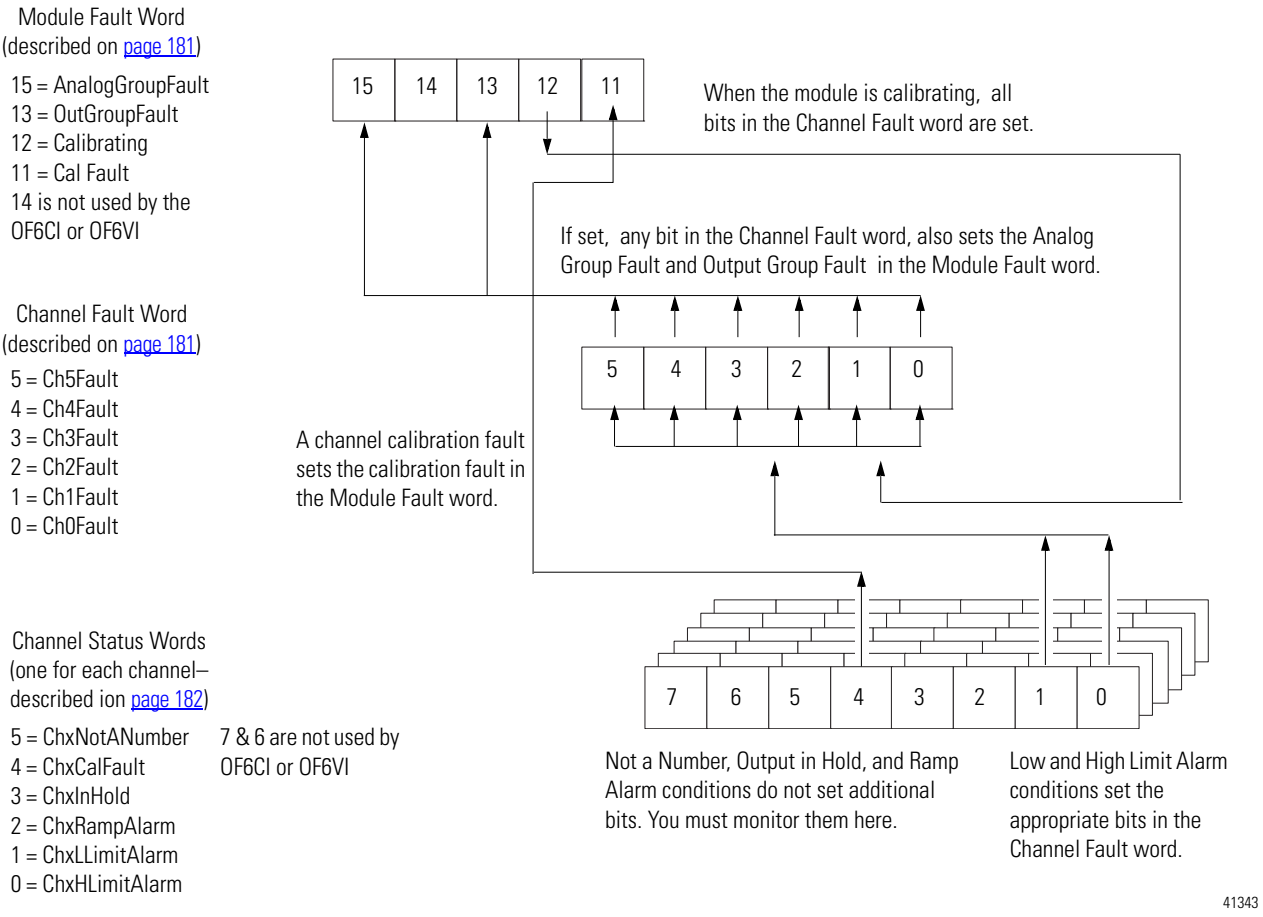
The table lists tags that can be examined in ladder logic to indicate when a fault occurs.

Tag	Description
Module Fault Word	This word provides fault summary reporting. Its tag name is ModuleFaults.
Channel Fault Word	This word provides underrange, overrange and communications fault reporting. Its tag name is ChannelFaults.
Channel Status Words	This word provides individual channel underrange and overrange fault reporting for process alarms, rate alarms and calibration faults. Its tag name is ChxStatus.

IMPORTANT Differences exist between floating point and integer modes as they relate to module fault reporting. These differences are explained in the following two sections.

Fault Reporting in Floating Point Mode

The illustration offers an overview of the fault reporting process in floating point mode.


Module Fault Word
(described on page 181)
15 = AnalogGroupFault
13 = OutGroupFault
12 = Calibrating
11 = Cal Fault
14 is not used by the OF6CI or OF6VI
15
14
13
12
11
When the module is calibrating, all bits in the Channel Fault word are set.
If set, any bit in the Channel Fault word, also sets the Analog Group Fault and Output Group Fault in the Module Fault word.
Channel Fault Word
(described on page 181)
5 = Ch5Fault
4 = Ch4Fault
3 = Ch3Fault
2 = Ch2Fault
1 = Ch1Fault
0 = Ch0Fault
5
4
3
2
1
0
A channel calibration fault sets the calibration fault in the Module Fault word.
Channel Status Words
(one for each channel–described ion page 182)
5 = ChxNotANumber
4 = ChxCalFault
3 = ChxInHold
2 = ChxRampAlarm
1 = ChxLLimitAlarm
0 = ChxHLimitAlarm
7 & 6 are not used by OF6CI or OF6VI
7
6
5
4
3
2
1
0
Not a Number, Output in Hold, and Ramp Alarm conditions do not set additional bits. You must monitor them here.
Low and High Limit Alarm conditions set the appropriate bits in the Channel Fault word.
41343

Module Fault Word Bits – Floating Point Mode

Bits in this word provide the highest level of fault detection. A nonzero condition in this word reveals that a fault exists on the module. You can examine further down to isolate the fault.

The table lists tags that are found in the Module Fault Word:

Tag	Description
Analog Group Fault	This bit is set when any bits in the Channel Fault word are set. Its tag name is AnalogGroupFault.
Output Group Fault	This bit is set when any bits in the Channel Fault word are set. Its tag name is OutputGroupFault.
Calibrating	This bit is set when any channel is being calibrated. When this bit is set, all bits in the Channel Fault word are set. Its tag name is Calibrating.
Calibration Fault	This bit is set when any of the individual Channel Calibration Fault bits are set. Its tag name is CalibrationFault.

Channel Fault Word Bits – Floating Point Mode

During normal module operation, Channel Fault word bits are set if any of the respective channels has a High or Low Limit Alarm. Checking this word for a nonzero condition is a quick way to check for High or Low Limit Alarm condition on a channel.

The table lists the conditions that set **all** Channel Fault word bits:

This condition sets all Channel Fault word bits	And causes the module to display the following in the Channel Fault word bits
A channel is being calibrated	'003F' for all bits
A communications fault occurred between the module and its owner-controller	'FFFF' for all bits

Your logic should monitor the Channel Fault bit for a particular output, if you either:

- set the high and low limit alarms outside your operating range.
- disable output limiting.

Channel Status Word Bits – Floating Point Mode

Any of the six Channel Status words, one for each channel, will display a nonzero condition if that particular channel has faulted for the conditions listed below. Some of these bits set bits in other Fault words.

When the High or Low Limit Alarm bits (bits 1 and 0) in any of the words are set, the appropriate bit is set in the Channel Fault word.

When the Calibration Fault bit (bit 4) is set in any of the words, the Calibration Fault bit (bit 11) is set in the Module Fault word. The table lists the conditions that set each of the word bits.

Tag (Status word)	Bit	Event that sets this tag
ChxNotaNumber	Bit 5	This bit is set when the output value received from the controller is NotaNumber (the IEEE NAN value). The output channel will hold its last state.
ChxCalFault	Bit 4	This bit is set when an error occurred when calibrating. This bit also sets the appropriate bit in the Channel Fault word.
ChxInHold	Blt 3	This bit is set when the output channel is currently holding. The bit resets when the requested Run mode output value is within 0.1% of full-scale of the current echo value.
ChxRampAlarm	Bit 2	This bit is set when the output channel's requested rate of change would exceed the configured maximum ramp rate requested parameter. It remains set until the output reaches its target value and ramping stops. If the bit is latched, it will remain set until it is unlatched.
ChxLLimitAlarm	Bit 1	This bit is set when the requested output value is beneath the configured low limit value. It remains set until the requested output is above the low limit. If the bit is latched, it will remain set until it is unlatched.
ChxHLimitAlarm	Bit 0	This bit is set when the requested output value is above the configured high limit value. It remains set until the requested output is below the high limit. If the bit is latched, it will remain set until it is unlatched.

IMPORTANT The 1756-OF6CI and 1756-OF6VI modules do not use bits 6 or 7 in this mode.

Fault Reporting in Integer Mode

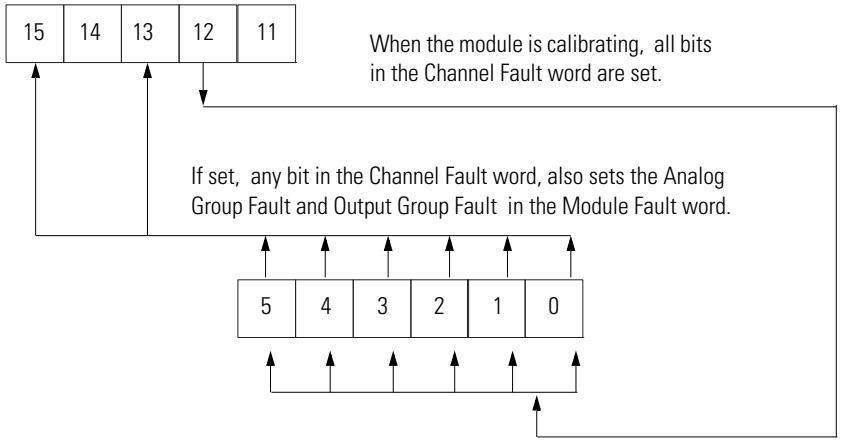
The illustration offers an overview of the fault reporting process in integer mode.

Module Fault Word
(described on page 184)

15 = AnalogGroupFault
13 = OutGroupFault
12 = Calibrating
11 = Cal Fault
14 is not used by the 1756-OF6CI or 1756-OF6VI.

Channel Fault Word
(described on page 184)

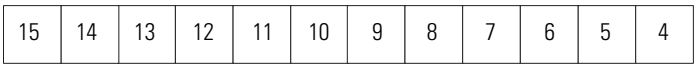
5 = Ch5Fault
4 = Ch4Fault
3 = Ch3Fault
2 = Ch2Fault
1 = Ch1Fault
0 = Ch0Fault



Channel Status Words
(described on page 185)

14 = Ch0InHold
12 = Ch1InHold
10 = Ch2InHold
8 = Ch3InHold
6 = Ch4InHold
4 = Ch5InHold

15, 13, 11, 9, 7, & 5 are not used by the 1756-OF6CI and 1756-OF6VI in integer mode.



Output in Hold conditions must be monitored here.

41349

Module Fault Word Bits – Integer Mode

In integer mode, Module Fault word bits (bits 15…11) operate exactly as described in floating point mode. The table lists tags that are found in the Module Fault Word.

Tag	Description
Analog Group Fault	This bit is set when any bits in the Channel Fault word are set. Its tag name is AnalogGroupFault.
Output Group Fault	This bit is set when any bits in the Channel Fault word are set. Its tag name is OutputGroupFault.
Calibrating	This bit is set when any channel is being calibrated. When this bit is set, all bits in the Channel Fault word are set. Its tag name is Calibrating.
Calibration Fault	This bit is set when any of the individual Channel Calibration Fault bits are set. Its tag name is CalibrationFault.

Channel Fault Word Bits – Integer Mode

In integer mode, Channel Fault word bits (bits 5…0) operate exactly as described in floating point mode for calibration and communications faults. The table lists the conditions that set all Channel Fault word bits.

This condition sets all Channel Fault word bits	And causes the module to display the following in the Channel Fault word bits
A channel is being calibrated	'003F' for all bits
A communications fault occurred between the module and its owner-controller	'FFFF' for all bits

Your logic should monitor the Channel Fault bit for a particular output, if you either:

- set the high and low limit alarms outside your operating range
- disable output limiting.

Channel Status Word Bits in Integer Mode

The Channel Status word has the following differences when used in integer mode.

- Only the Output in Hold condition is reported by the module.
- Calibration Fault reporting is not available in this word, although the Calibration Fault bit in the Module Fault word will still activate when that condition exists on any channel.
- There is only one Channel Status word for all six channels.

The table lists the conditions that set each of the word bits.

Tag (Status word)	Bit	Event that sets this tag
ChxInHold	Even-numbered bits from bit 14…bit 0 (that is, bit 14 represents channel 0). For a full listing of the channels these bits represent, see page 183.	The Output In Hold bit is set when the output channel is currently holding. The bit resets when the requested Run mode output value is within 0.1% of full-scale of the current echo value.

IMPORTANT The 1756-OF6CI and 1756-OF6VI modules do not use bits 15, 13, 11, 9, 7 or 5 in this mode.

Notes:

Install ControlLogix I/O Modules

Introduction

This chapter describes how to install ControlLogix modules.

Topic	Page
Install the I/O Module	187
Key the Removable Terminal Block	188
Connect Wiring	189
Assemble the RTB and the Housing	194
Install the Removable Terminal Block	195
Remove the Removable Terminal Block	196
Remove the Module from the Chassis	197

Install the I/O Module

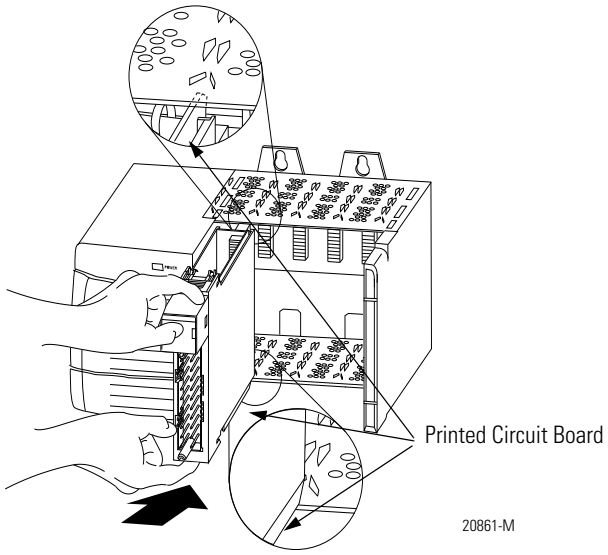
You can install or remove a module while chassis power is applied.

ATTENTION

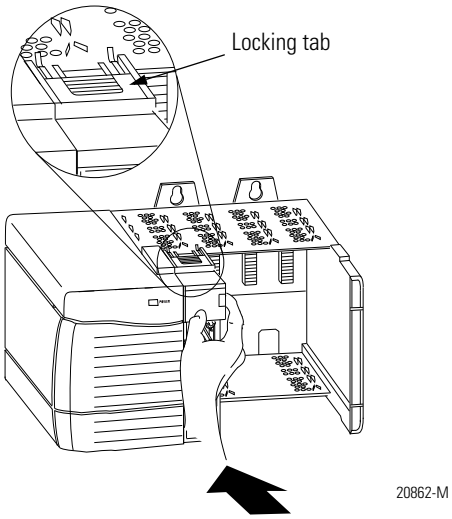
The module is designed to support Removal and Insertion Under Power (RIUP). However, when you remove or insert an RTB with field-side power applied, unintended machine motion or loss of process control can occur. Exercise extreme caution when using this feature.

Do these steps to install an I/O module.

1. Align the circuit board with the top and bottom chassis guides.



2. Slide the module into the chassis until the module locking tab clicks.



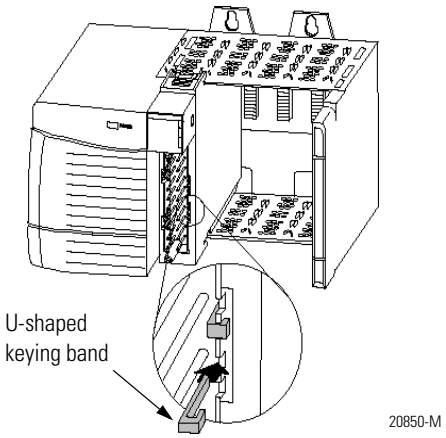
Key the Removable Terminal Block

Key the RTB to prevent inadvertently connecting the incorrect RTB to your module. When the RTB mounts onto the module, keying positions will match up.

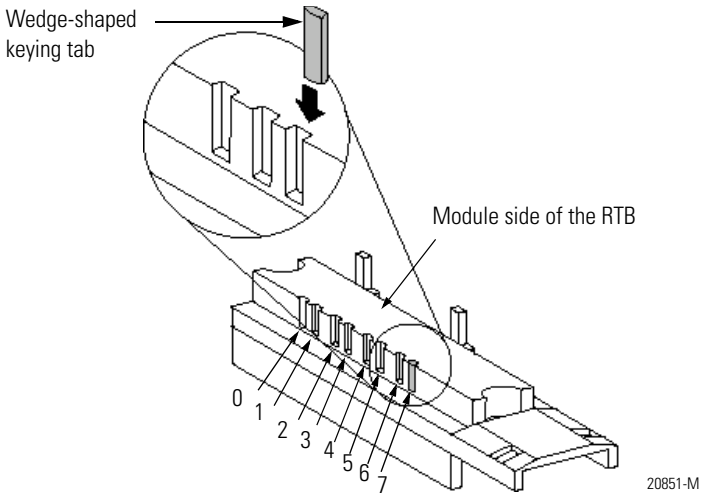
For example, if you place a U-shaped keying band in slot 4 on the module, you cannot place a wedge-shaped tab in slow 4 on the RTB or your RTB will not mount on the module. We recommend that you use a unique keying pattern for each slot in the chassis.

1. Insert the U-shaped band with the long side near the terminals.

2. Push the band onto the module until it snaps into place.



3. Key the RTB in positions that correspond to unkeyed module positions. Insert the wedge-shaped tab on the RTB with the rounded edge first. Push the tab onto the RTB until it stops.



Connect Wiring

You can use an RTB or a Bulletin 1492 pre-wired Analog Interface Module (AIFM)[(1)] to connect wiring to your module. If you are using an RTB, follow the directions in this section to connect wires to the RTB. An AIFM has been pre-wired before you received it.

If you are using an AIFM to connect wiring to the module, skip this section and see page 383.

IMPORTANT

For all ControlLogix analog modules, except the 1756-IR6I, we recommend you use Belden 8761 cable to wire the RTB. For the 1756-IR6I module, we recommend you use Belden 9533 or 83503 cable to wire the RTB.

The RTB terminations can accommodate 22…14 gauge shielded wire.

(1) The ControlLogix system has been agency certified using only the ControlLogix RTBs (1756-TBCH, 1756-TBNH, 1756-TBSH and 1756-TBS6H). Any application that requires agency certification of the ControlLogix system using other wiring termination methods may require application specific approval by the certifying agency.

The table provides a quick reference to wiring guidelines for these analog I/O modules.

Cat. No.	Page
1756-IF16	70
1756-IF8	74
1756-IF6CIS	106
1756-IF6I	109
1756-IR6I	138
1756-IT6I	139
1756-IT6I2	140
1756-OF4	157
1756-OF8	158
1756-OF6CI	177
1756-OF6VI	178

Connect the Grounded End of the Cable

Before wiring the RTB, you must connect the ground wiring.

1. Do the following steps to ground the drain wire.

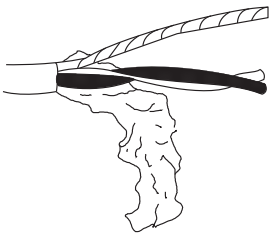
IMPORTANT

For all ControlLogix analog I/O modules except the 1756-IF6CIS module, we recommend you ground the drain wire at the field-side. If you cannot ground at the field-side, ground at an earth ground on the chassis, as shown on page 191.

For the 1756-IF6CIS, we recommend you ground the module as shown on page 191.

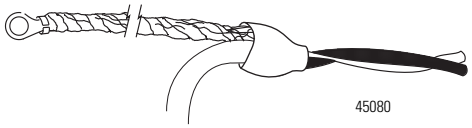
d. Remove a length of cable jacket from the Belden cable.

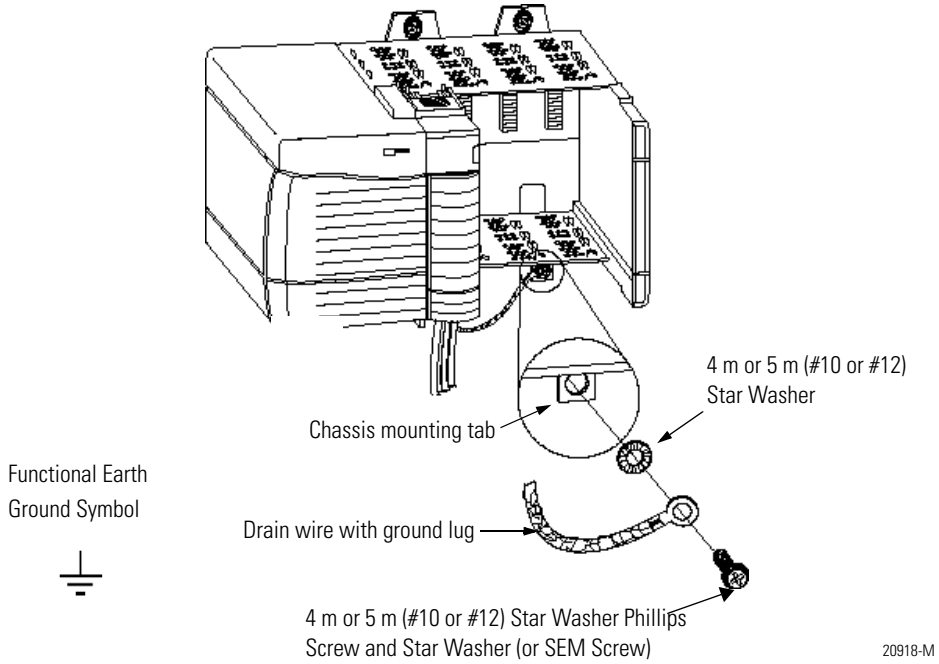
e. Pull the foil shield and bare drain wire from the insulated wire.



f. Twist the foil shield and drain wire together to form a single strand.

g. Attach a ground lug and apply heat shrink tubing to the exit area.




4 m or 5 m (#10 or #12)
Star Washer
Chassis mounting tab
Functional Earth
Ground Symbol
Drain wire with ground lug
4 m or 5 m (#10 or #12) Star Washer Phillips
Screw and Star Washer (or SEM Screw)
20918-M

2. Connect the drain wire to a chassis mounting tab.

Use any chassis mounting tab that is designated as a functional signal ground. The functional earth ground symbol appears near the tab.

3. When the drain wire is grounded, connect the insulated wires to the field-side.

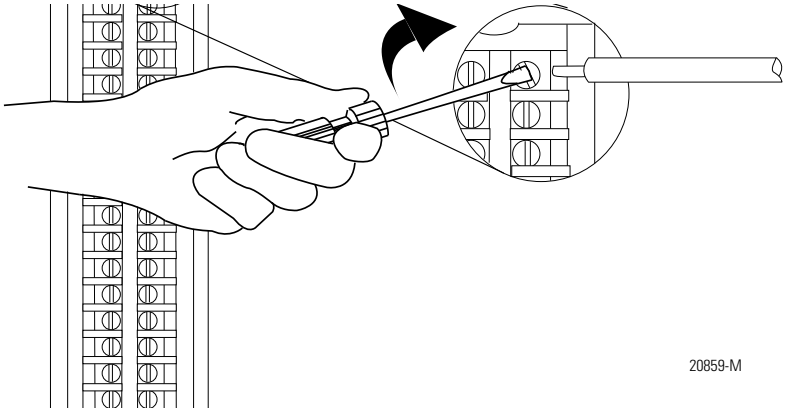
Connect the Ungrounded End of the Cable

1. Cut the foil shield and drain wire back to the cable casing and apply shrink wrap.
2. Connect the insulated wires to the RTB.

Three Types of RTBs (each RTB comes with housing)

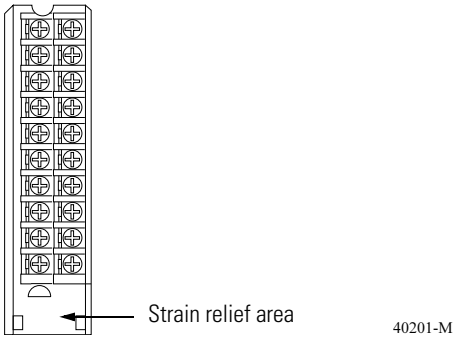
Cage clamp - catalog number 1756-TBCH

1. Insert the wire into the terminal.
2. Turn the screw clockwise to close the terminal on the wire.



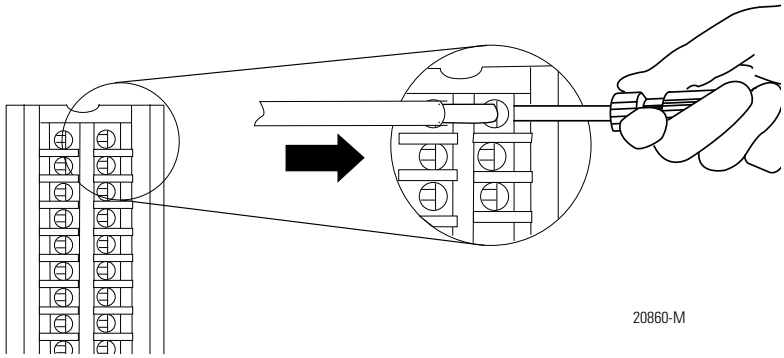
NEMA clamp - Catalog number 1756-TBNH

Terminate wires at the screw terminals.



Spring clamp - catalog number 1756-TBS6H

1. Insert the screwdriver into the outer hole of the RTB.
2. Insert the wire into the open terminal and remove the screwdriver.



ATTENTION

The ControlLogix system has been agency certified using only the ControlLogix RTBs (catalog numbers 1756-TBCH, 1756-TBNH, 1756-TBSH and 1756-TBS6H). Any application that requires agency certification of the ControlLogix system using other wiring termination methods may require application specific approval by the certifying agency.

Recommendations for Wiring Your RTB

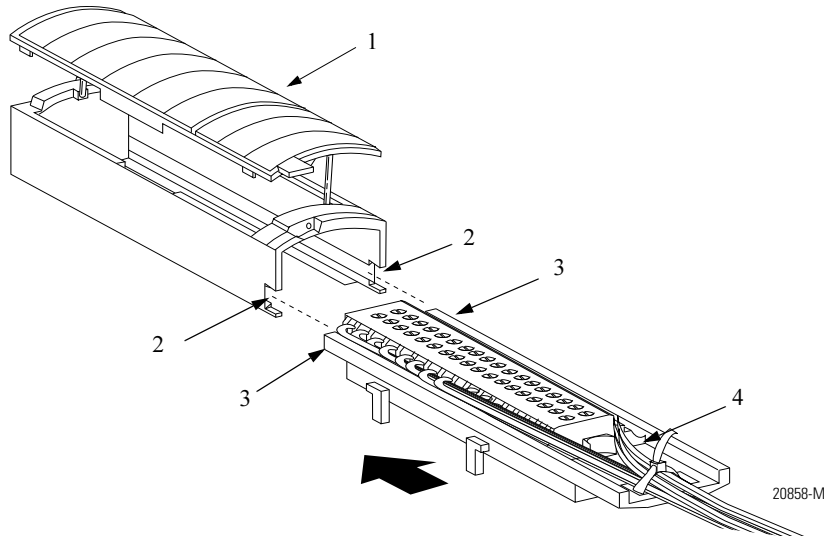
We recommend you follow these guidelines when wiring your RTB.

1. Begin wiring the RTB at the bottom terminals and move up.
2. Use a tie to secure the wires in the strain relief (bottom) area of the RTB.
3. Order and use an extended-depth housing (catalog number 1756-TBE) for applications that require heavy gauge wiring.

Assemble the RTB and the Housing

Removable housing covers the wired RTB to protect wiring connections when the RTB is seated on the module.

1. Align the grooves at the bottom of each side of the housing with the side edges of the RTB.
2. Slide the RTB into the housing until it snaps into place.



Item	Description
1	Housing cover
2	Groove
3	Side edge of RTB
4	Strain relief area

IMPORTANT If additional wire routing space is required for your application, use the extended-depth housing, catalog number 1756-TBE.

Install the Removable Terminal Block

These steps show how to install the RTB onto the module to connect the wiring.

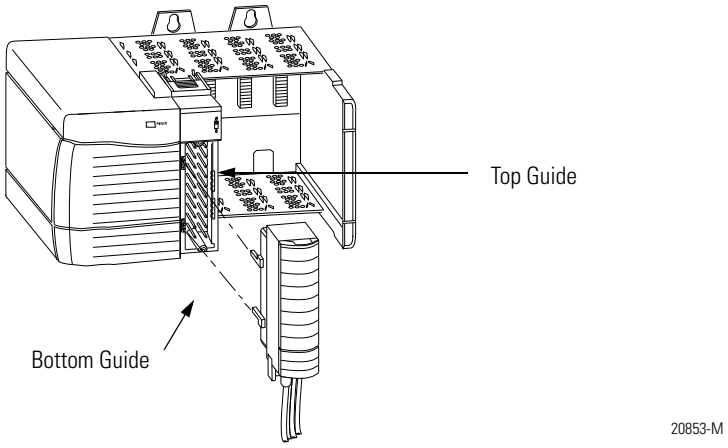
WARNING

When you connect or disconnect the removable terminal block (RTB) with field-side power applied, an electrical arc can occur. This could cause an explosion in hazardous location installations. Be sure that power is removed or the area is nonhazardous before proceeding.

Before installing the RTB, make certain:

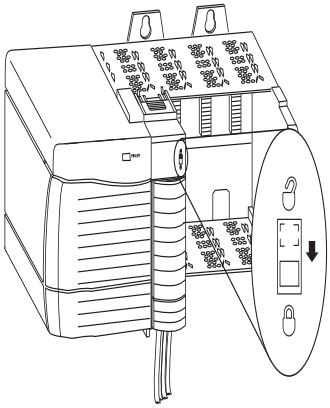
- field-side wiring of the RTB has been completed.
- the RTB housing is snapped into place on the RTB.
- the RTB housing door is closed.
- the locking tab at the top of the module is unlocked.

1. Align the top, bottom, and left side guides of the RTB with the guides on the module.



2. Press quickly and evenly to seat the RTB on the module until the latches snap into place.

3. Slide the locking tab down to lock the RTB onto the module.



Remove the Removable Terminal Block

If you need to remove the module from the chassis, you must first remove the RTB from the module. Do these steps to remove the RTB.

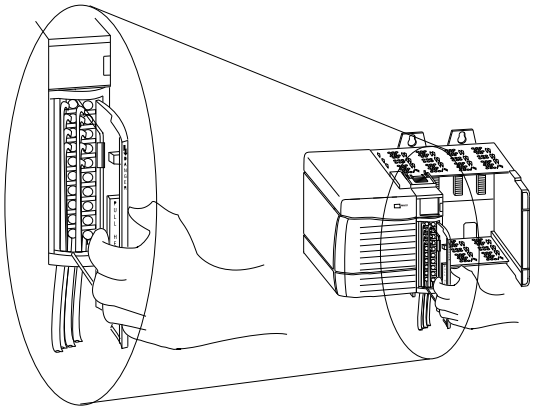
WARNING

When you insert or remove the module while backplane power is on, an electrical arc can occur. This could cause an explosion in hazardous location installations. Be sure that power is removed or the area is nonhazardous before proceeding.

Repeated electrical arcing causes excessive wear to contacts on both module and its mating connector. Worn contacts may create electrical resistance that can affect module operation.

1. Unlock the locking tab at the top of the module.
2. Open the RTB door by using the bottom tab.

3. Hold the spot marked PULL HERE and pull the RTB off the module.



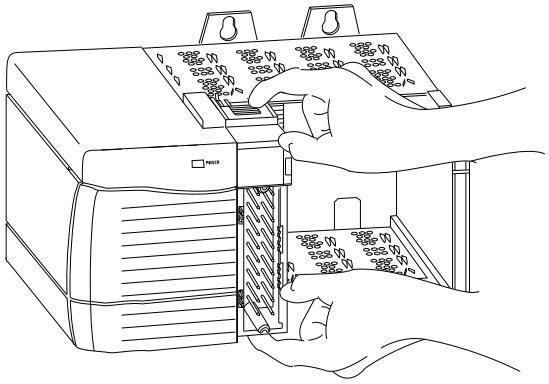
20855-M

IMPORTANT Do not wrap your fingers around the entire door. A shock hazard exists.

Remove the Module from the Chassis

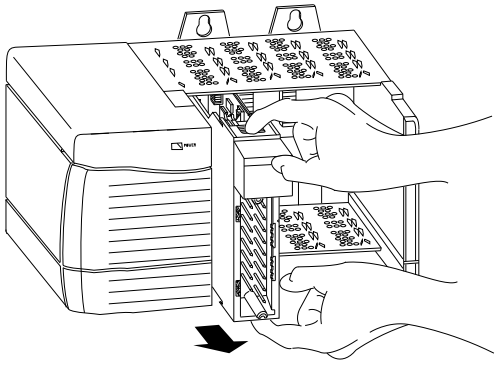
Follow these steps to remove a module from its chassis.

1. Push in the top and bottom locking tabs.



20856-M

2. Pull the module out of the chassis.



20857-M

Notes:

Configure ControlLogix Analog I/O Modules

Introduction

You must configure your module upon installation. The module will not work until it has been configured.

In most cases, you will use RSLogix 5000 programming software to configure your analog I/O module. The programming software uses default configurations, such as RTS, RPI, and so forth, to get your I/O module to communicate with the owner-controller.

However, there are situations in which you might want to modify the default settings. You can maintain custom settings on tabs from the Module Properties dialog box. This section provides step-by-step instructions for creating default and custom configurations

Topic	Page
Full Configuration Profile Diagram	201
Create a New Module	202
Modify Default Configuration for Input Modules	207
Configure the RTD Module	215
Configure the Thermocouple Modules	216
Modify Default Configuration for Output Modules	218
Download Configuration Data to the Module	225
Edit Configuration	226
Reconfigure Module Parameters in Run Mode	227
Reconfigure Parameters in Program Mode	229
Configure I/O Modules in a Remote Chassis	230
View Module Tags	232

IMPORTANT

This section focuses on configuring I/O modules in a local chassis. To configure I/O modules in a remote chassis, you must follow all the detailed procedures with two additional steps. See page 230 for details.

RSLogix 5000 programming software must be installed on your computer to complete the procedures for both default and custom configurations.

For software installation instructions and to learn how to navigate the software package, see the RSLogix 5000 Getting Results Guide.

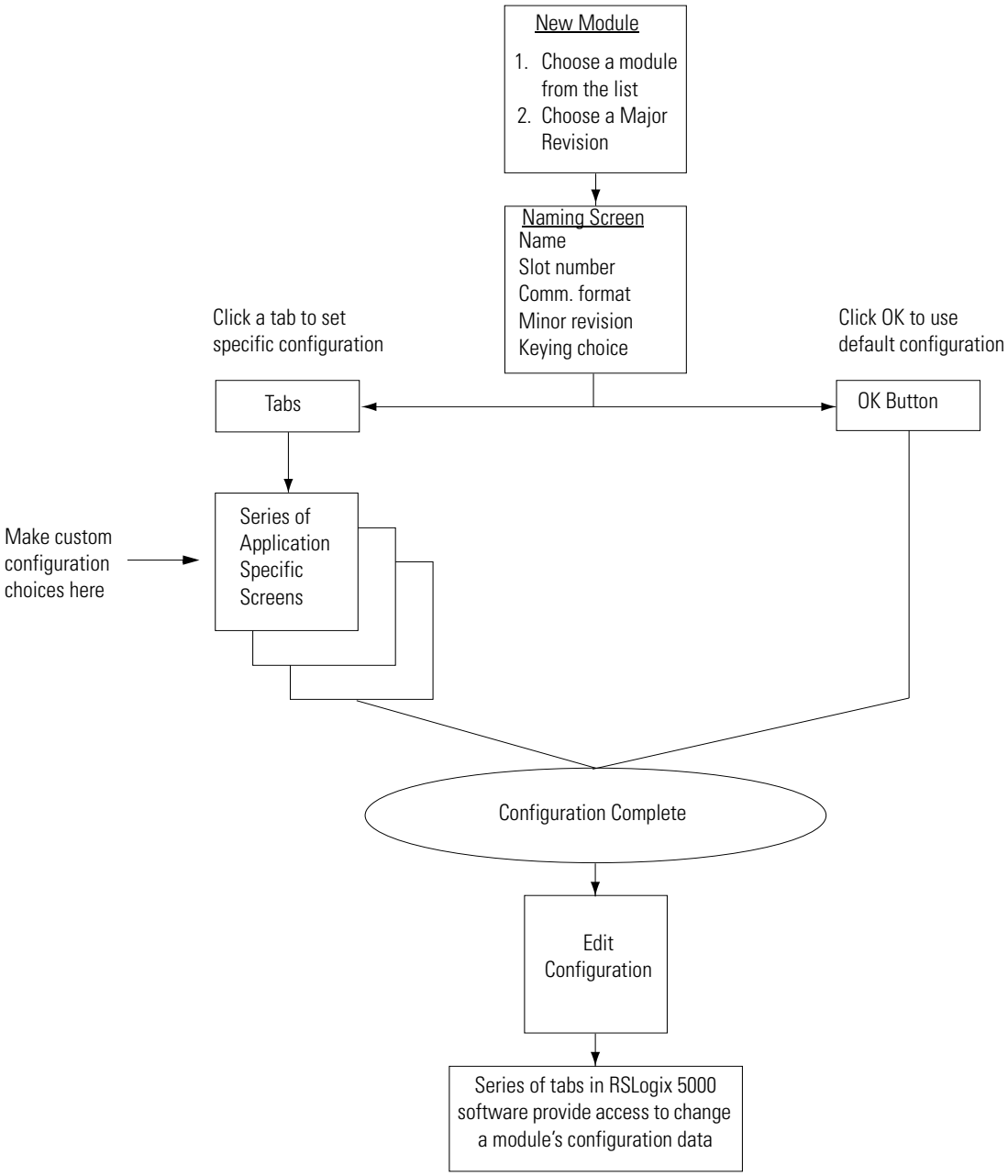
Configuration Process Overview

Follow these basic steps to configure a ControlLogix analog I/O module by using the RSLogix 5000 software.

1. Create a new module.
2. Accept the default configuration or change it to specific configuration (customized) for the module.
3. Edit a configuration for a module when changes are needed.

Each of these steps is explained in detail in the following pages. A chart that shows the full configuration profile is on page 201.

Full Configuration Profile Diagram

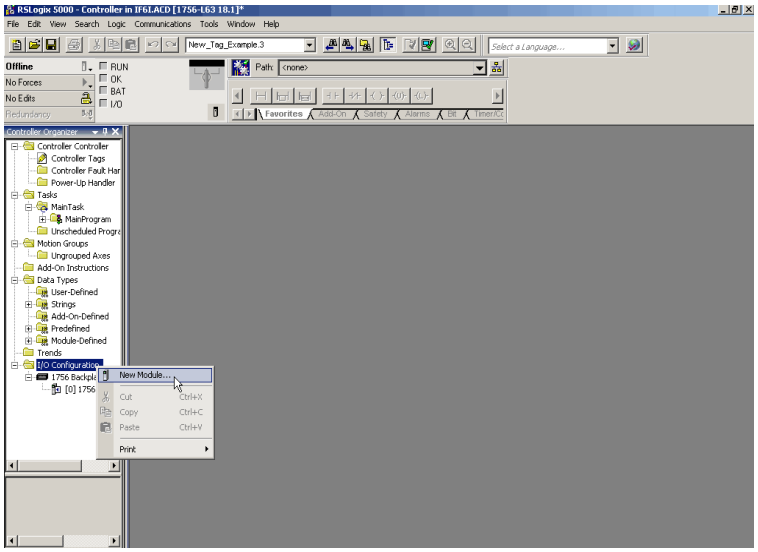


Create a New Module

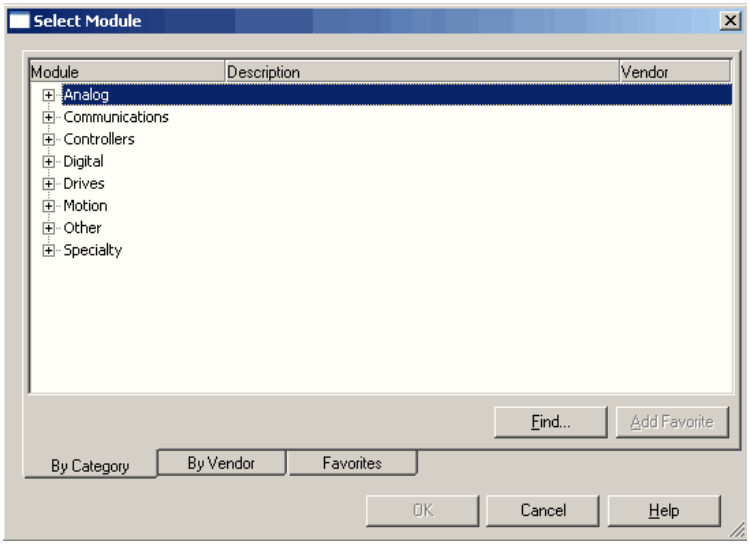
After starting the RSLogix 5000 programming software and creating a controller, you are ready to create a new module. You can use a default configuration or set up a custom, or specific, configuration for your application program.

IMPORTANT RSLogix 5000 software, version 15 and later, lets you add I/O modules online. When using any previous version, you must be offline when you create a new module.

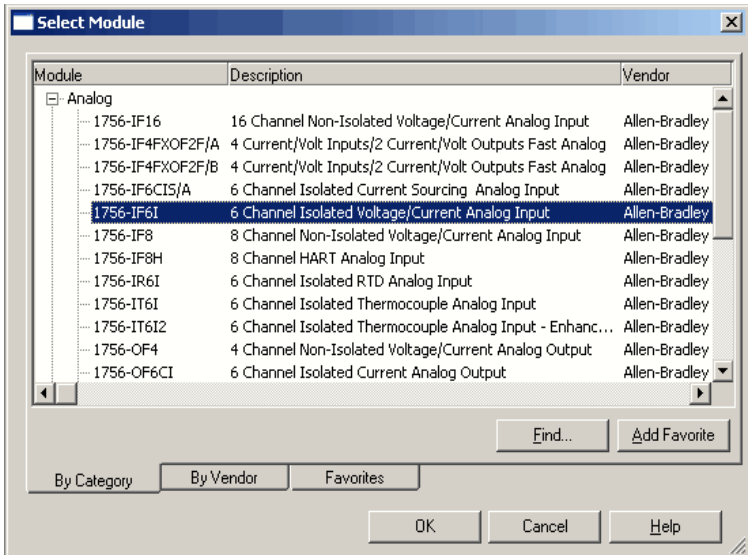
1. On the Controller Organizer, right-click I/O Configuration and choose New Module.



The Select Module dialog box appears.



2. Click the '+' next to Analog for a list for this module group.

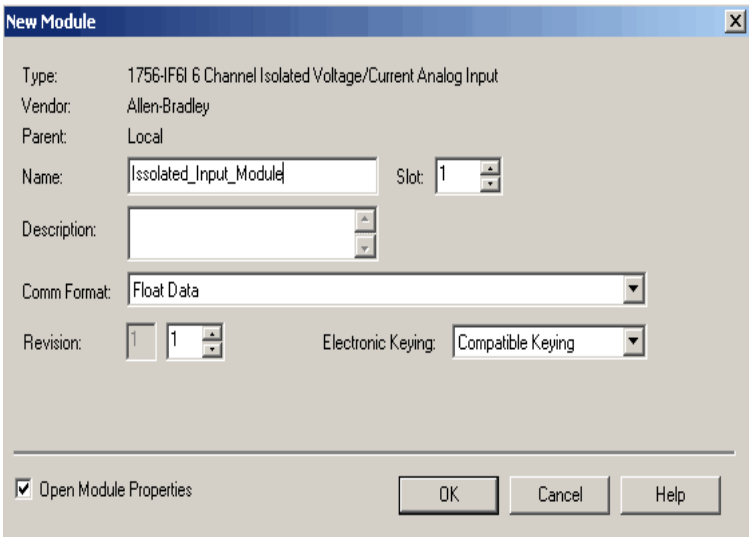

Select Module
Module
Description
Vendor
Analog
1756-IF16 16 Channel Non-Isolated Voltage/Current Analog Input Allen-Bradley
1756-IF4FXOF2F/A 4 Current/Volt Inputs/2 Current/Volt Outputs Fast Analog Allen-Bradley
1756-IF4FXOF2F/B 4 Current/Volt Inputs/2 Current/Volt Outputs Fast Analog Allen-Bradley
1756-IF6CIS/A 6 Channel Isolated Current Sourcing Analog Input Allen-Bradley
1756-IF6I 6 Channel Isolated Voltage/Current Analog Input Allen-Bradley
1756-IF8 8 Channel Non-Isolated Voltage/Current Analog Input Allen-Bradley
1756-IF8H 8 Channel HART Analog Input Allen-Bradley
1756-IR6I 6 Channel Isolated RTD Analog Input Allen-Bradley
1756-IT6I 6 Channel Isolated Thermocouple Analog Input Allen-Bradley
1756-IT6I2 6 Channel Isolated Thermocouple Analog Input - Enhanc... Allen-Bradley
1756-OF4 4 Channel Non-Isolated Voltage/Current Analog Output Allen-Bradley
1756-OF6CI 6 Channel Isolated Current Analog Output Allen-Bradley
Find...
Add Favorite
By Category
By Vendor
Favorites
OK
Cancel
Help

3. Select a module and click OK.

4. Click OK to accept the default major revision.

TIP To find the revision number, open RSLinx software. Click the RSWho icon and choose the network. Open the module, and then right-click the module to choose Properties in the pull-down menu. The revision number is among the properties.

The New Module dialog box appears.



5. In the Name box, type a module name.

6. In the slot box, enter the module's slot number.
7. In the Description box, type an optional description for the module.
8. From the Comm Format pull-down menu, choose a communication format.

   See page 205 for a description of the communication format choices.

IMPORTANT Make sure you choose the correct communication format for your application because you cannot change the selection after the program is downloaded with the controller. You will have to reconfigure the module to change the communication format.

9. Choose an electronic keying method.

   See page 37 for details.

10. Do one of the following to either accept default configuration settings or edit configuration data.
    a. To accept the default configuration settings, make sure Open Module Properties is not checked and then click OK.
    b. To set up a custom configuration, make sure Open Module Properties is checked and then click OK.

       The New Module Properties dialog box appears with tabs for entry of additional configuration settings.

TIP When you choose a listen-only communication format, only the General and Connection tabs appear when you view a module's properties in RSLogix 5000 software.

Controllers that want to listen to a module but not own it use the listen-only communication format.

See page 205 for more information on communication formats.

Communication Format

The communication format determines:

- what type of configuration options are made available.
- what type of data is transferred between the module and its owner-controller.
- what tags are generated when configuration is complete.

The communication format also returns status and rolling timestamp data.

Once a module is created, you cannot change the communication format unless you delete and recreate the module.

The table describes communication formats used with analog input modules.

Input Module Communication Formats

If you want the input module to return this data	Choose this communication format
Floating point input data	Float data
Integer input data	Integer data
Floating point input data with the value of the coordinated system time (from its local chassis) when the input data is sampled	CST timestamped float data
Integer input data with the value of the coordinated system time (from its local chassis) when the input data is sampled	CST timestamped integer data
Floating point input data with the value of the coordinated system time (from its local chassis) when the input data is sampled when the 1756-IF16 or 1756-IF8 module is operating in the differential mode	CST timestamped float data - differential mode
Floating point input data with the value of the coordinated system time (from its local chassis) when the input data is sampled when the 1756-IF16 or 1756-IF8 module is operating in the high-speed mode	CST timestamped float data - high-speed mode
Floating point input data with the value of the coordinated system time (from its local chassis) when the input data is sampled when the 1756-IF16 or 1756-IF8 module is operating in the single-ended mode	CST timestamped float data - single-ended mode
Integer input data with the value of the coordinated system time (from its local chassis) when the input data is sampled when the 1756-IF16 or 1756-IF8 module is operating in the differential mode	CST timestamped integer data - differential mode
Integer input data with the value of the coordinated system time (from its local chassis) when the input data is sampled when the 1756-IF16 or 1756-IF8 module is operating in the high-speed mode	CST timestamped integer data - high-speed mode
Integer input data with the value of the coordinated system time (from its local chassis) when the input data is sampled when the 1756-IF16 or 1756-IF8 module is operating in the single-ended mode	CST timestamped integer data - single-ended mode

Input Module Communication Formats

If you want the input module to return this data	Choose this communication format
Floating point input data when the 1756-IF16 or 1756-IF8 module is operating in the differential mode only	Float data - differential mode
Returns floating point input data when the 1756-IF16 or 1756-IF8 module is operating in the high-speed mode	Float data - high-speed mode
Floating point input data when the 1756-IF16 or 1756-IF8 module is operating in the single-ended mode	Float data - single-ended mode
Integer input data when the 1756-IF16 or 1756-IF8 module is operating in the differential mode	Integer data - differential mode
Integer input data when the 1756-IF16 or 1756-IF8 module is operating in the high-speed mode	Integer data - high-speed mode
Integer input data when the 1756-IF16 or 1756-IF8 module is operating in the single-ended mode	Integer data - single-ended mode
Specific input data that is used by a controller that does not own the input module These choices have the same definition as the similarly-named options above except that they represent listen-only connections between the analog input module and a listen-only controller	Listen only CST timestamped float data
	Listen only CST timestamped integer data
	Listen only float data
	Listen only integer data
	Listen only CST timestamped float data - differential mode
	Listen only CST timestamped float data - high-speed mode
	Listen only CST timestamped float data - single-ended mode
	Listen only CST timestamped integer data - differential mode
	Listen only CST timestamped integer data - high-speed mode
	Listen only CST timestamped integer data - single-ended mode
	Listen only Float data - differential mode
	Listen only Float data - high-speed mode
	Listen only Float data - single-ended mode
	Listen only Integer data - differential mode
	Listen only Integer data - high-speed mode
	Listen only Integer data - single-ended mode

Output Module Formats

The table describes the communication formats used with analog output modules.

Output Module Communication Formats

If you want the output module return this data	Choose this communications format
Floating point output data	Float data
Integer output data	Integer data
Floating point output data and receives data echo values with a CST timestamp value	CST timestamped float data
Integer output data and receives data echo values with a CST timestamp value	CST timestamped integer data
Specific input data that is used by a controller that does not own the output module These choices have the same definition as the similarly-named options above except that they represent listen-only connections between the analog output module and a listen-only controller	Listen only float data
	Listen only integer data
	Listen only CST timestamped float data
	Listen only CST timestamped integer data

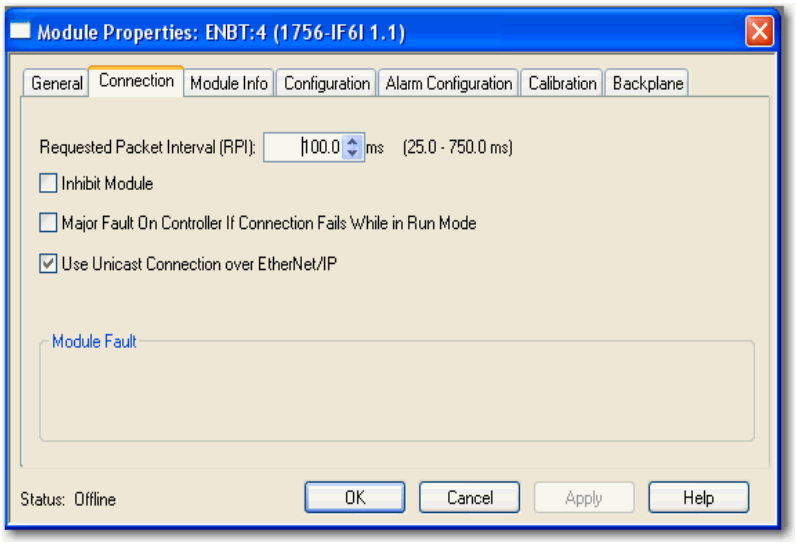
Modify Default Configuration for Input Modules

RSLogix 5000 programming software automatically creates module-defined data types and tags when a module is created. This section describes how to modify the default configuration for input modules.

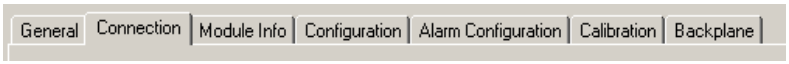
Data types symbolically name module configuration, input and output data. Tags let you provide each a unique name, such as where the user-defined data type and slot reside on the controller. This information is used to communicate data between the controller and module.

Follow these steps to modify a default configuration.

1. On the New Module dialog box, make sure Open Module Properties is checked.
2. Click OK.



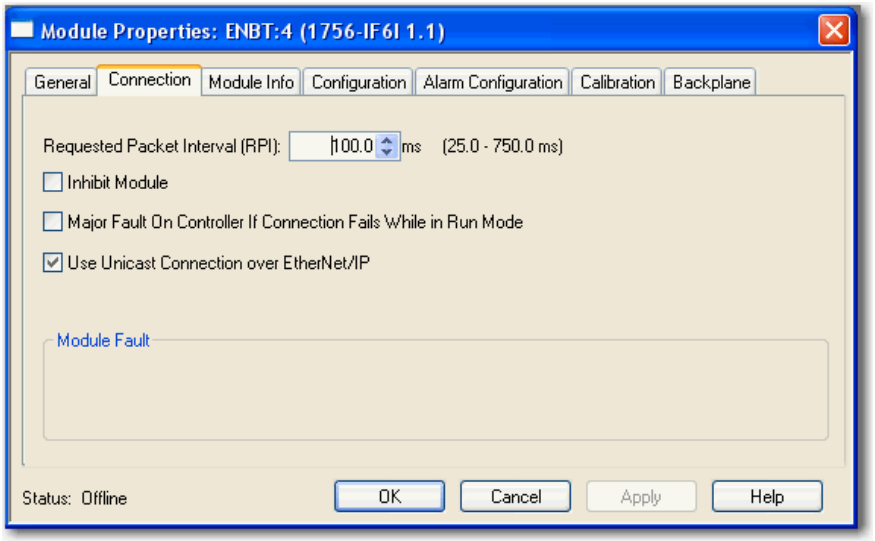
The Module Properties dialog box appears with tabs to access additional module information. The Connection tab is the default.



TIP Tabs can be selected in any order. The following examples are for instructional purposes.

Connection Tab

The Connection tab on the Module Properties dialog box lets you enter a requested packet interval (RPI), inhibit a module, and set a connection fault when the module is in Run mode. The RPI provides a defined, maximum period of time when data is transferred to the owner-controller.



1. Choose from the options on the Connection tab.

Field Name	Description
Requested Packet Interval (RPI)	Enter an RPI value or use the default. See Requested Packet Interval (RPI) in Chapter 2 for more information.
Inhibit Module	Check the box to prevent communication between the owner-controller and the module. This option allows for maintenance of the module without faults being reported to the controller. See Module Inhibiting in Chapter 3 for more information.
Major Fault On Controller If Connection Fails While in Run Mode	Check the box to create a major fault if there is a connection failure with the module while in Run mode. For important information on this checkbox, see 'Configure a Major Fault to Occur' in the Logix5000 Controllers Information and Status Programming Manual, publication 1756-PM015.

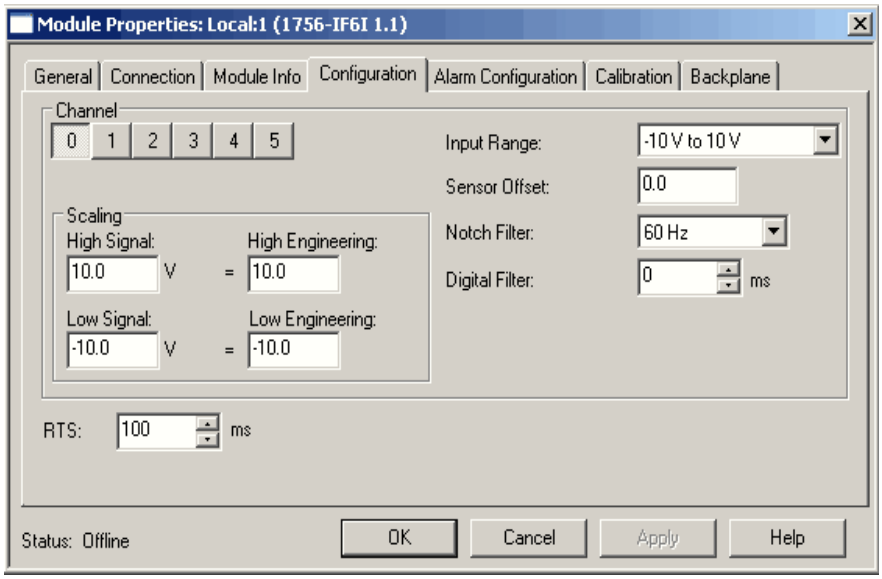
Field Name	Description
Use Unicast Connection on EtherNet/IP	Displays only for analog modules using RSLogix5000 software version 18 or later in a remote EtherNet/IP chassis. Use the default checkbox if there are no other controllers in 'Listen' mode. Clear the box if there are other 'listening' controllers in the system.
Module Fault	The fault box is empty if you are offline. The type of connection fault appears in the text box if a fault occurs when the module is online.

2. Do one of the following:

   - Click Apply to store a change but stay on the dialog box to choose another tab.
   - Click OK if you are finished making changes.

Configuration Tab

The Configuration tab on the Module Properties dialog box lets you program information on a channel-by-channel or module-wide basis. The number of channels depends on the selected input module.



1. Choose from the options on the Configuration tab.

Field Name	Description
Channel	Click the channel that is being configured.
Input Range	Choose the module's input range to determine the minimum and maximum signals that are detected by the module. See .page 49 in Chapter 3 for a chart showing range and resolution per module.
Sensor Offset	Type a value to compensate for any sensor offset errors.
Notch Filter	Use the default (60 Hz) or choose a frequency that attenuates the input signal at this specified frequency.
Digital Filter	Choose a value in milliseconds that specifies the time constant for a digital first order lag filter on the input. A value of 0 disables the filter. See page 62 in Chapter 4 for an amplitude chart example.
Scaling	You can scale only with the **floating point data format**. Scaling lets you configure two points in the module's operating range with the associated low and high points for this range. See page 50 in Chapter 3 for details.
RTS	Choose a value in milliseconds that the module performs a Real Time Sample (RTS). This parameter determines when the module scans all input channels, stores data into memory, and multicasts the update channel data. **Note:** If the RTS value is less than or equal to the RPI, each multicast of data from the module will have updated channel information. If the RTS value is greater than the RPI, the module multicats at both the RTS value and the RPI rate. The module resets the RPI timer each time an RTS is performed.

IMPORTANT The 1756-IR6I, 1756-IT6I, and 1756-IT6I2 modules have additional configurations, such as temperature units and cold option junctions. See page 215 and page 216 for dialog box examples.

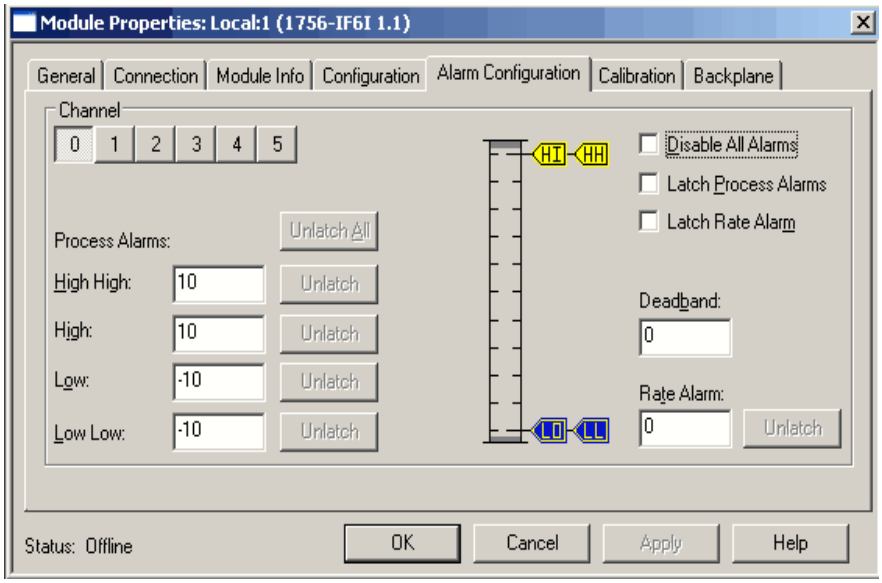
2. After the channels are configured, do one of the following:

   - Click Apply to store a change but stay on the dialog box to choose another tab.
   - Click OK if you are finished making changes.

Alarm Configuration Tab

The Alarm Configuration tab on the Module Properties dialog box lets you program high and low limits, disable and latch alarms, and set a deadband or rate alarm per channel.

For alarm information, see page 63 and page 64.



1. Choose from the options on the Alarm Configuration tab.

Field Name	Description
Channel	Click the channel that is being configured.

Field Name	Description
Process Alarms[1] High High High Low Low Low	Type a value for each of the four alarm trigger points that alert you when the module has exceeded these limitations. You also can use the respective slider icon to set a trigger value. The Unlatch buttons are enabled only when the module is online.
Disable All Alarms	Check the box to disable all alarms. **Important:** When you disable all alarms, you disable process, rate, and channel diagnostic alarms (for example, underrange and overrange). We recommend that you disable only unused channels so extraneous alarm bits are not set.
Latch Process Alarms	Check the box to latch an alarm in the set position even if the condition that causes the alarm disappears.
Latch Rate Alarms	Check the box if the rate of change between input samples exceeds the trigger point for the channel. See page 64 in Chapter 4 for a sample rate of change formula.
Deadband	Type a deadband value that works with the process alarms. The deadband gauges the input data to set or remove an alarm for a process alarm. See an alarm deadband chart on page 63 in Chapter 4.
Rate Alarm[2]	Type a value used to determine the rate of change to trigger a rate alarm.

(1) Process alarms are not available in integer mode or in applications by using the 1756-IF16 module in the single-ended, floating point mode. The values for each limit are entered in scaled engineering units.

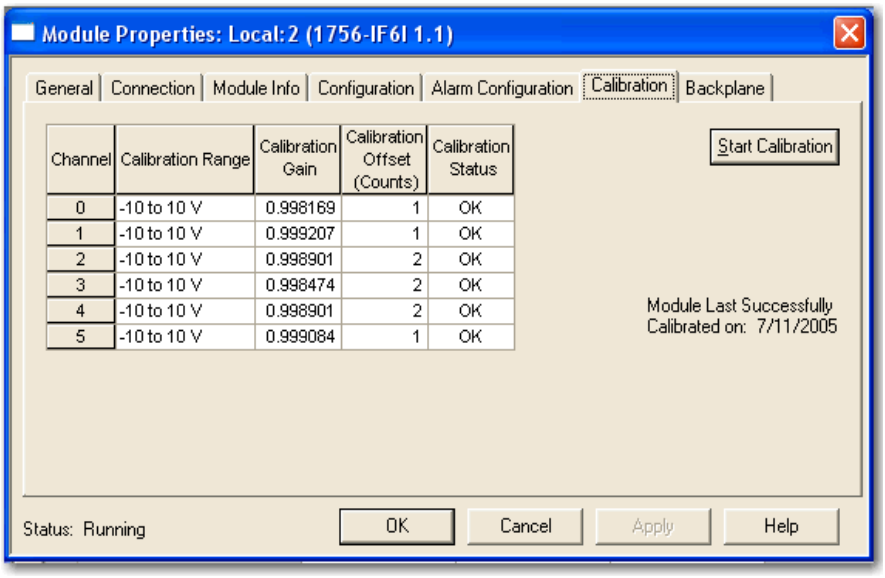
(2) Rate alarms are not available in integer mode or in applications by using the 1756-IF16 module in the single-ended, floating point mode. The values for each limit are entered in scaled engineering units.

2. After the channels are configured, do one of the following:

   - Click Apply to store a change but stay on the dialog box to choose another tab.
   - Click OK to apply the change and close the dialog box.
   - Click Cancel to close the dialog box without applying changes.

Calibration Tab

The Calibration tab on the Module Properties dialog box lets you recalibrate the default factory calibrations, if necessary. Calibration corrects any hardware inaccuracies on a particular channel.



See page 233 in Chapter 11 for specific module calibrations.

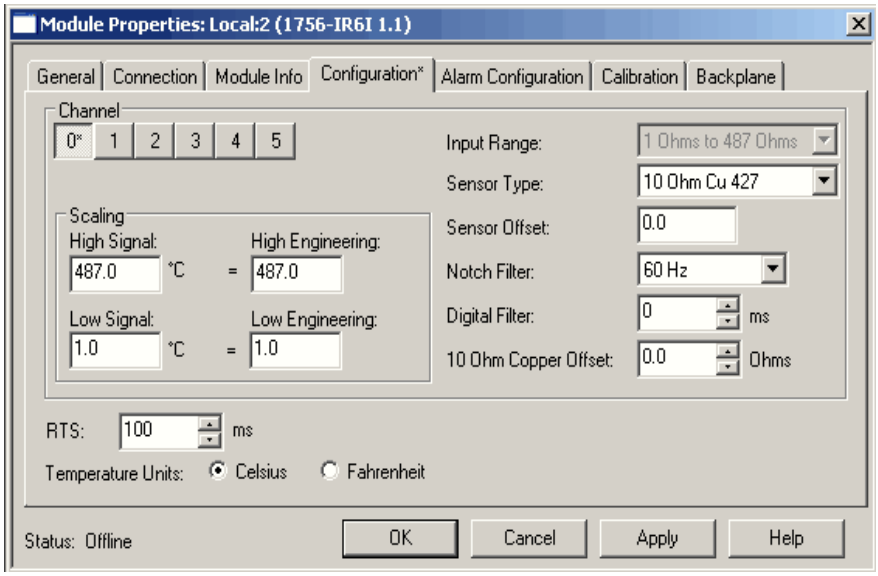
Although each dialog box maintains importance during online monitoring, some of the tabs, such as the Module Info and Backplane, are blank during the initial module configuration.

Some of the analog input modules, for example the 1756-IR6I and 1756-IT6I modules, have additional configurations. These configuration dialog boxes are explained on the following pages.

Configure the RTD Module

The Resistance Temperature Detector (RTD) module (1756-IR6I) has additional configurable points, temperature units, and 10 Ω copper offset options.

All of this module's configuration tabs match the series listed for input modules, beginning on page 207, except for the Configuration Tab. The dialog box example and table show the additional settings for the 1756-IR6I module's temperature-measuring capability.



1. Choose from the additional options on the Configuration tab.

Field Name	Description
Sensor Type	Choose a RTD sensor type.
10 Ohm Copper Offset	This feature needs to be set only if you choose a Copper Sensor Type. Choose a value to compensate for any copper offset errors.
Temperature Units Celsius Fahrenheit	Select the temperature unit that affects all channels per module.

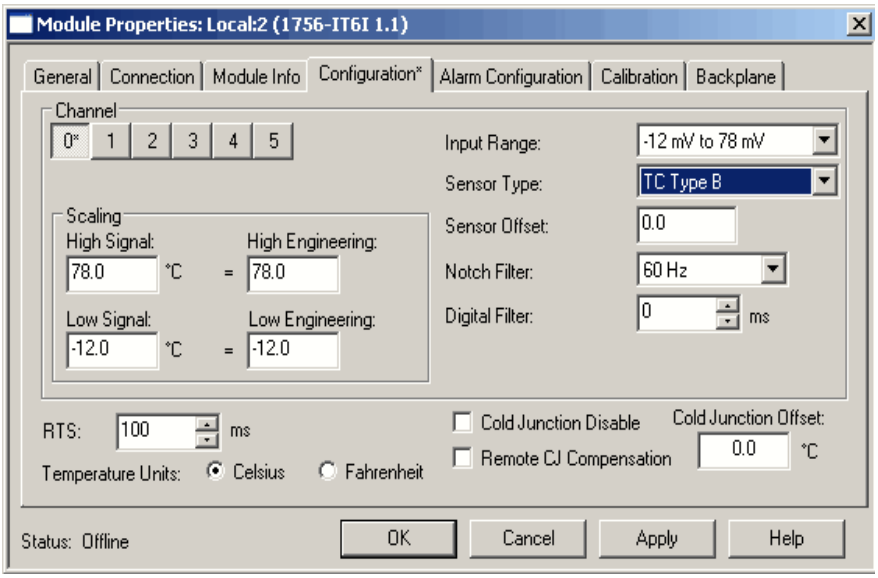
2. After the channels are configured, do one of the following:

   - Click Apply to store a change but stay on the dialog box to choose another tab.
   - Click OK to apply the change and close the dialog box.
   - Click Cancel to close the dialog box without applying changes.

Configure the Thermocouple Modules

The 1756-IT6I and 1756-IT6I2 modules have additional configurable points, temperature units, and cold junction options.

All of this module's configuration screens match the series listed for input modules, beginning on page 207, except for the Configuration Tab. The dialog box example and table show the additional settings for the 1756-IT6I and 1756-IT6I2 modules' temperature-measuring capability.



1. Choose from the additional options on the Configuration tab.

Field Name	Description
Sensor Type	Choose a thermocouple sensor type.
Cold Junction Offset	Choose a value to compensate for additional voltage that effects the input signal. See page 132 in Chapter 6 for details.
Cold Junction Disable	Check the box to disable the cold junction.
Remote CJ Compensation	Check the box to enable cold junction compensation for a remote module.
Temperature Units Celsius Fahrenheit	Select the temperature unit that affects all channels per module.

IMPORTANT The module sends back temperature values over the entire sensor range as long as the High signal value equals the High engineering value and the Low signal value equals the Low engineering value.

For the example above, if:

High signal = 78.0 °C, High engineering must = 78.0.

Low signal = -12.0 °C, Low engineering must = -12.0

2. After the channels are configured, do one of the following:

- Click Apply to store a change but stay on the dialog box to choose another tab.
- Click OK to apply the change and close the dialog box.
- Click Cancel to close the dialog box without applying changes.

Modify Default Configuration for Output Modules

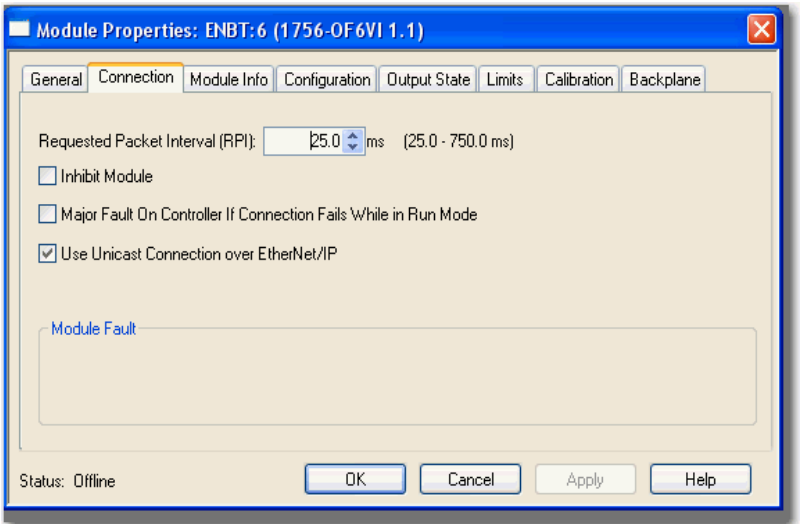
RSLogix 5000 programming software automatically creates module-defined data types and tags when a module is created. This section describes how to modify the default configuration for output modules.

Data types symbolically name module configuration, input and output data. Tags let you provide each a unique name, such as where the user-defined data type and slot reside on the controller. This information is used to communicate data between the controller and module.

Follow these steps to modify a default configuration.

1. On the New Module dialog box, make sure Open Module Properties is checked.

2. Click OK.

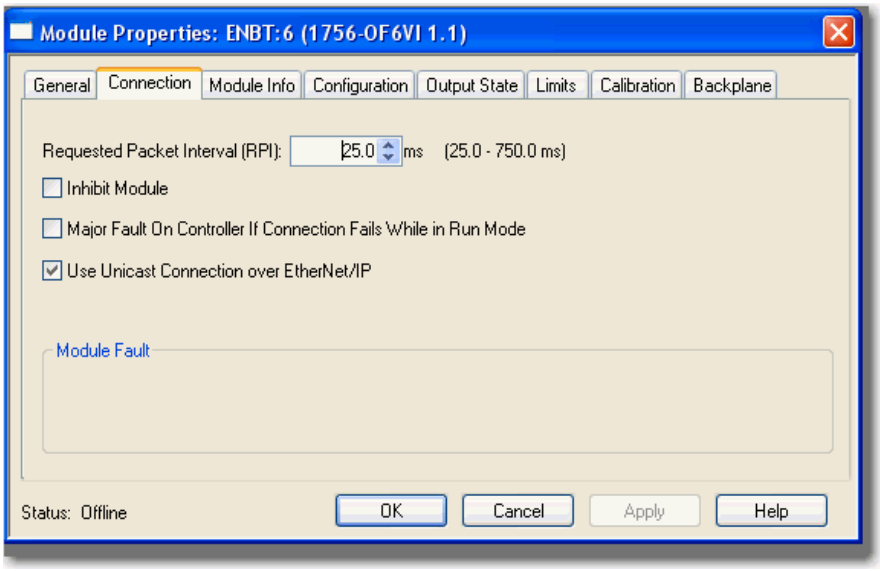


The Module Properties dialog box appears with tabs to access additional module information. The Connection tab is the default.

TIP Tabs can be selected in any order. The following examples are for instructional purposes.

Connection Tab

The Connection tab on the Module Properties dialog box lets you enter a requested packet interval (RPI), inhibit a module, and set a connection fault when the module is in Run mode. The RPI provides a defined, maximum period of time when data is transferred to the owner-controller.



1. Choose from the options on the Connection tab.

Field Name	Description
Requested Packet Interval (RPI)	Enter an RPI value or use the default. See Requested Packet Interval (RPI) in Chapter 2 for more information.
Inhibit Module	Check the box to prevent communication between the owner-controller and the module. This option allows for maintenance of the module without faults being reported to the controller. See Module Inhibiting in Chapter 3 for more information.
Major Fault On Controller If Connection Fails While in Run Mode	Check the box to create a major fault if there is a connection failure with the module while in Run mode. For important information on this checkbox, see 'Configure a Major Fault to Occur' in the Logix5000 Controllers Information and Status Programming Manual, publication 1756-PM015.

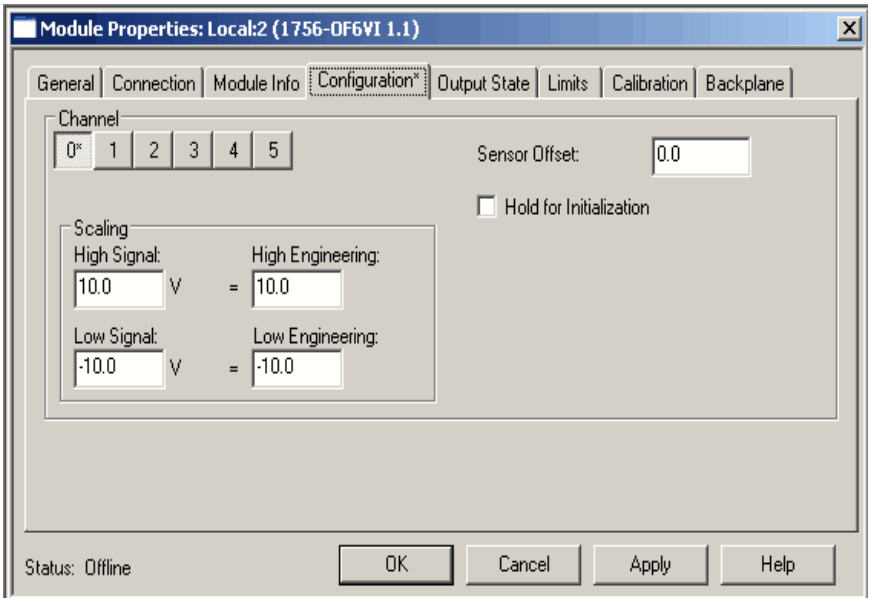
Field Name	Description
Use Unicast Connection on EtherNet/IP	Displays only for analog modules using RSLogix5000 software version 18 or later in a remote EtherNet/IP chassis. Use the default checkbox if there are no other controllers in 'Listen' mode. Clear the box if there are other 'listening' controllers in the system.
Module Fault	The fault box is empty if you are offline. The type of connection fault appears in the text box if a fault occurs when the module is online.

2. Do one of the following:

   - Click Apply to store a change but stay on the dialog box to choose another tab.
   - Click OK to apply the change and close the dialog box.
   - Click Cancel to close the dialog box without applying changes.

Configuration Tab

The Configuration tab lets you program information on a channel-by-channel basis. The number of channels depends on the selected output module.



1. Choose from the options on the Configuration tab.

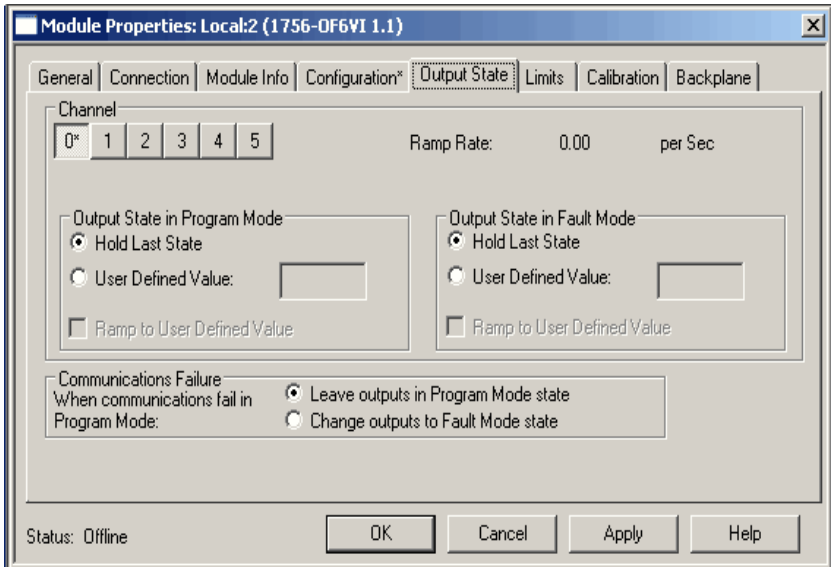
Field Name	Description
Channel	Click the channel that is being configured.
Sensor Offset	Type a value to compensate for any sensor offset errors.
Hold for Initialization	Check the box to have outputs hold their present state until the output values match the controller values. See page 169 in Chapter 8 for details.
Scaling	You can scale only with the **floating point data format**. Scaling lets you configure any two signal points in the module's operating range with the associated low and high points for this range. See page 50 in Chapter 3 for details.

2. After the channels are configured, do one of the following:

   - Click Apply to store a change but stay on the dialog box to choose another tab.
   - Click OK to apply the change and close the dialog box.

Output State Tab

The Output State tab lets you program output behavior in Program and Fault modes.



1. Choose from the options on the Output State tab.

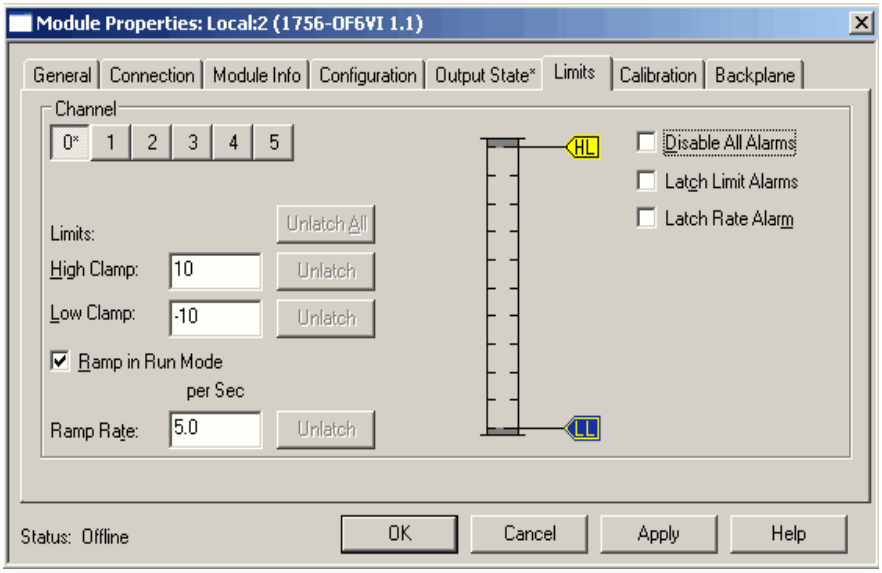
Field Name	Description
Channel	Click the channel that is being configured.
Ramp Rate	Displays the ramp rate set on the Limits tab.
Output State in Program Mode Hold Last State User Defined Value	Select the output behavior in Program mode. If User Defined Value, type a value for the output to transition to when in Program mode.
Ramp to User Defined Value	Box is enabled if User Default Value is entered. Check the box for ramping to occur when the present output value changes to the User Default Value after a Program command is received from the controller. See page 169 in Chapter 8 for details.
Output State in Fault Mode Hold Last State User Defined Value	Select the output behavior in Fault mode. If User Defined Value, type a value for the output to transition to when a communicaton fault occurs.
Ramp to User Defined Value	Box is enabled if User Default Value is entered. Check the box for ramping to occur when the present output value changes to the Fault Value after a communication fault. See page 169 in Chapter 8 for details.
Communication Failure When communication fails in Program Mode: Leave outputs in Program Mode state Change outputs to Fault Mode state	Select the behavior of the outputs if communication fails in Program mode. **Important:** Outputs always go to Fault mode if communications fail in Run mode.

2. After the channels are configured, do one of the following:

   - Click Apply to store a change but stay on the dialog box to choose another tab.
   - Click OK to apply the change and close the dialog box.
   - Click Cancel to close the dialog box without applying changes.

Limits Tab

The Limits tab lets you program clamping and ramp limitations that may prevent damage to equipment.



1. Choose from the options on the Limits tab.

Field Name	Description
Channel	Click the channel that is being configured.
Limits High Clamp Low Clamp	Type a high and low clamp value that limits the output from the analog module within this range. See page 152 and page 170 for details. See Important on page 224.
Ramp in Run Mode	Check the box to enable ramping in Run mode.
Ramp Rate	Entry field is enabled if the Ramp in Run Mode box is checked. Type a value that sets the maximum ramp rate for a module in Run mode. See page 169 in Chapter 8 for details.
Disable All Alarms	Check the box to disable all alarms. **Important:** When you disable all alarms, you disable process, rate, and channel diagnostic alarms (for example, underrange and overrange). We recommend that you disable only unused channels so extraneous alarm bits are not set.

Field Name	Description
Latch Limit Alarms	Check the box to latch an alarm if the controller data value exceeds the clamping limit. See page 170 in Chapter 8 for details.
Latch Rate Alarm	Check the box to latch an alarm if the output single changes at a rate that exceeds the ramping limit. See page 169 in Chapter 8 for details.

IMPORTANT

Clamping is only available in floating point mode.

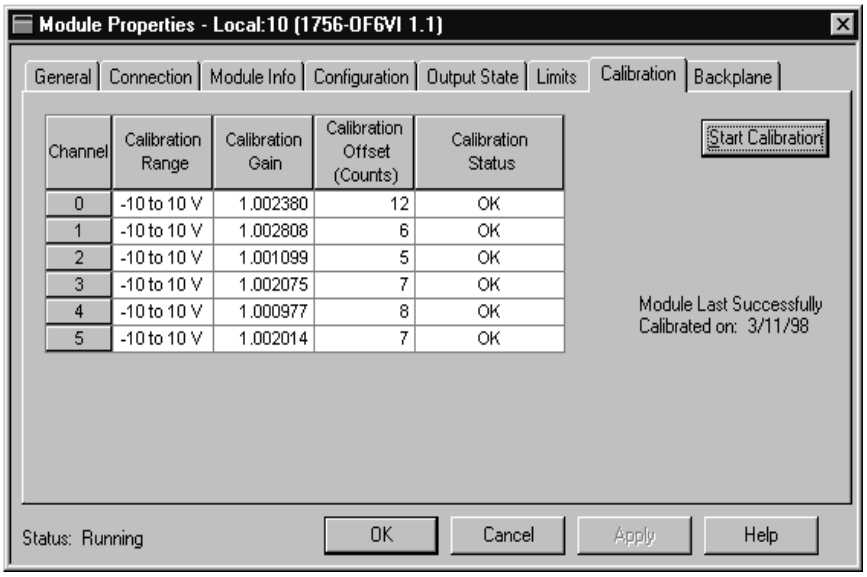
Clamp values are in engineering scaling units and are not automatically updated when the engineering high and low scaling units are changed. Failure to update the clamp values may generate a very small output signal that could be misinterpreted as a hardware problem.

2. After the channels are configured, do one of the following:

   - Click Apply to store a change but stay on the dialog box to choose another tab.
   - Click OK to apply the change and close the dialog box.
   - Click Cancel to close the dialog box without applying changes.

Calibration Tab

The Calibration tab lets you recalibrate the default factory calibrations, if necessary. Calibration corrects any hardware inaccuracies on a particular channel.



See Chapter 11 for specific module calibrations.

Although each dialog box maintains importance during online monitoring, some of the tabs, such as the Module Info and Backplane, are blank during the initial module configuration.

Download Configuration Data to the Module

After you have changed the configuration data for a module, the change does not take affect until you download the new program that contains that information. This downloads the entire program to the controller, overwriting any existing programs.

Follow these steps to download the new program.

1. At the top, left corner of the RSLogix 5000 software program, click the status icon.
2. Choose Download.

   The Download dialog box appears.
3. Click Download.

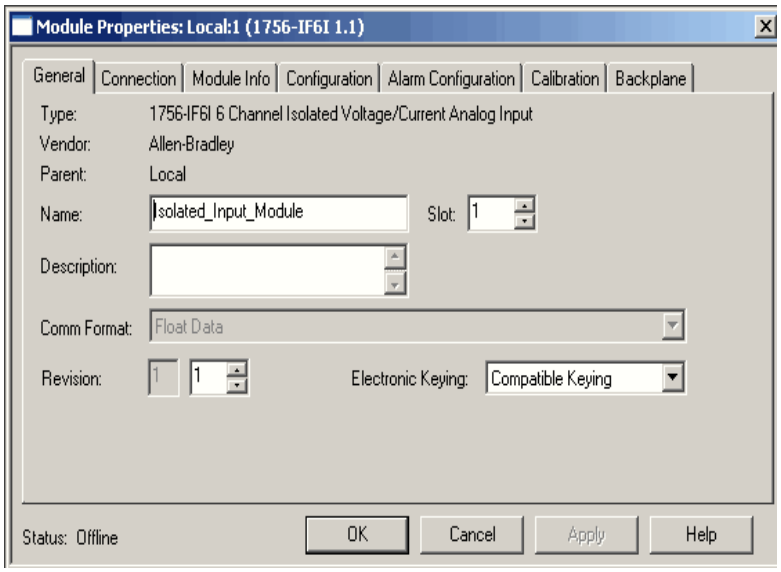
Edit Configuration

After you have set configuration for a module, you can review and change your choices in the RSLogix 5000 programming software. You can download the data to the controller while online. This is called dynamic reconfiguration.

Follow these steps to edit a module's configuration.

1. On the Controller Organizer, right-click an I/O module and choose Properties.

   The Module Properties dialog box appears.



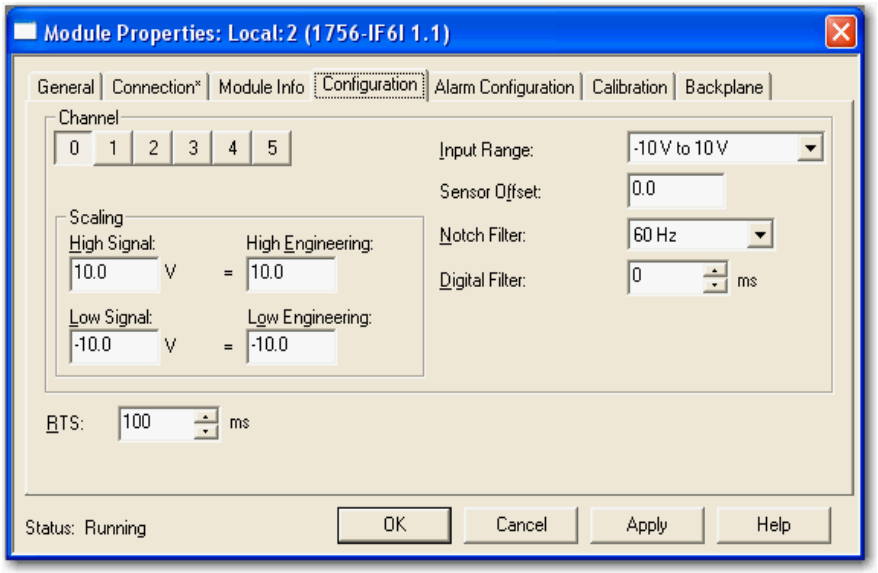
2. Click a tab that contains the fields that you want to edit.

3. Make any changes, and then click OK.

Reconfigure Module Parameters in Run Mode

Your module can operate in either Remote Run mode or Run mode. You can change any configurable features that are enabled by the software only in Remote Run mode.

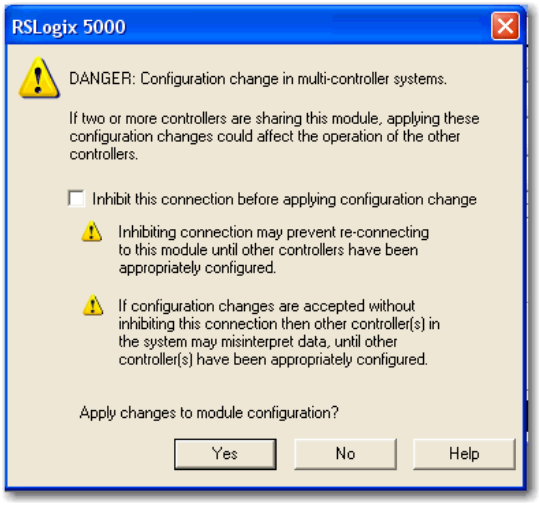
The example shows the Configuration tab for the 1756-IF6I module while it is in Run mode.



If any feature is disabled in either Run mode, change the controller to Program mode and follow these steps.

1. Make the necessary configuration changes.
2. Do one of the following:
   - Click Apply to store a change but stay on the dialog box to choose another tab.
   - Click OK if you are finished making changes.

When you try to download new configuration data to the module, the following warning appears.


RSLogix 5000
DANGER: Configuration change in multi-controller systems.
If two or more controllers are sharing this module, applying these configuration changes could affect the operation of the other controllers.
Inhibit this connection before applying configuration change
Inhibiting connection may prevent re-connecting to this module until other controllers have been appropriately configured.
If configuration changes are accepted without inhibiting this connection then other controller(s) in the system may misinterpret data, until other controller(s) have been appropriately configured.
Apply changes to module configuration?
Yes
No
Help

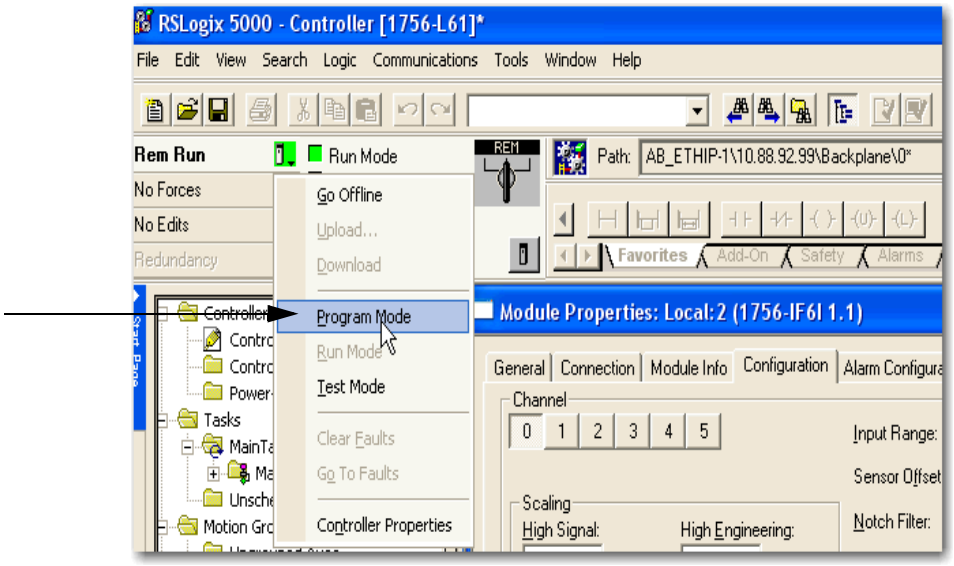
IMPORTANT If you change the configuration for a module, you must consider whether the module has more than one owner-controller. If so, be sure each owner has exactly the same configuration data as the others.

For more information on changing configuration in a module with multiple owner-controllers, see page 33.

Reconfigure Parameters in Program Mode

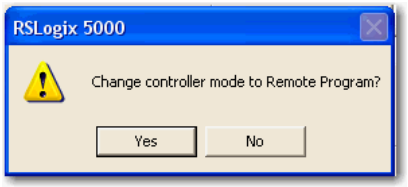
Change the module from either Run or Remote Run mode to Program mode before changing configuration in the Program mode. Follow these steps.

1. At the top, left corner of the RSLogix 5000 software program, click the status icon.



2. Choose Program mode.

   A window appears asking if you want to change the controller mode to remote program mode.



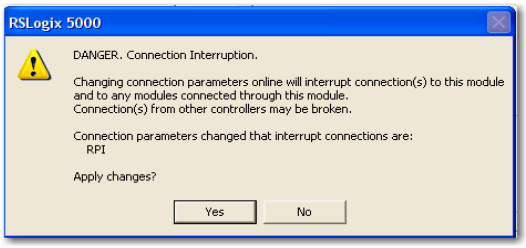
3. Click Yes.

4. Make any necessary changes. For example, the RPI can be only changed in Program mode.

5. Do one of the following:

   - Click Apply to store a change but stay on the dialog box to choose another tab.
   - Click OK if you are finished making changes.

Before the RPI rate is updated online, RSLogix 5000 software verifies your desired change.


RSLogix 5000
DANGER. Connection Interruption.
Changing connection parameters online will interrupt connection(s) to this module and to any modules connected through this module.
Connection(s) from other controllers may be broken.
Connection parameters changed that interrupt connections are:
RPI
Apply changes?
Yes
No

6. Click Yes to verify any software changes.

   The RPI, in this example, is changed and the new configuration data is transferred to the controller.

   We recommend that you change the module back to Run mode after changes are made in Program mode.

Configure I/O Modules in a Remote Chassis

There are separate communication modules available for different networks to configure I/O modules in a remote chassis. The ControlNet and EtherNet/IP communication modules must be configured in the local chassis and the remote chassis to handle network protocol.

You can then add new I/O modules to the program via the communication module.

Follow these steps to configure a communication module for the local chassis. This module handles communication between the controller chassis and the remote chassis.

1. On the Controller Organizer, right-click I/O Configuration and choose New Module.

   The Select Module dialog box appears.

2. Click the '+' next to Communications for a list of communication modules.

3. Choose a communication module for the local chassis and click OK.

4. Click OK to accept the default major revision.

   The New Module dialog box appears.

5. Configure the communication module in the local chassis.

For more information on the ControlLogix ControlNet module, see ControlNet Modules in Logix5000 Control Systems, publication CNET-UM001.

For more information on the ControlLogix EtherNet/IP Bridge module, see EtherNet/IP Modules in Logix5000 Control Systems User Manual, publication ENET-UM001.

6. Repeat steps 1…5 to configure a communication module for the remote chassis.

7. Configure the communication module in the remote chassis.

   Now you can configure the remote I/O modules by adding them to the remote communication module. Follow the same procedures as you do for configuring local I/O modules, starting on page 202.

8. Click Reset for the appropriate point setting in the Reset Latched Diagnostics column.

9. Click OK.

View Module Tags

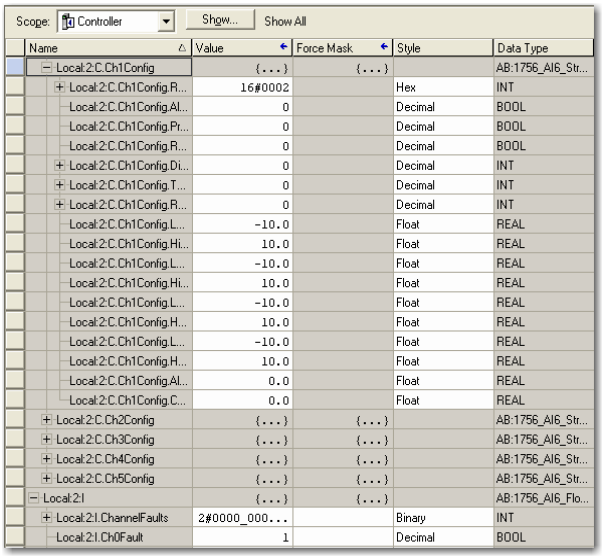
When you create a module, a set of tags is created by the ControlLogix system that can be viewed in the Tag Editor of the RSLogix 5000 software. Each configured feature on your module has a distinct tag that can be used in the processor's ladder logic.

Follow these steps to access a module's tags.

1. At the top of the Controller Organizer, right-click Controller tags and choose Monitor Tags.

   The Controller Tags dialog box appears with data.

2. Click the slot number of the module for which you want to view information.



   See Appendix B for details on configuration tags.

Calibrate the ControlLogix Analog I/O Modules

Introduction

Your ControlLogix analog I/O module comes from the factory with a default calibration. You may choose to recalibrate your module to increase its accuracy for your specific application.

You do not have to configure a module before you calibrate it. If you decide to calibrate your analog I/O modules first, you must add them to your program.

This chapter describes how to calibrate ControlLogix analog modules..

Topic	Page
Difference of Calibrating an Input Module and an Output Module	234
Calibrate Your Input Modules	235
Calibrate Your Output Modules	259

IMPORTANT

Analog I/O modules can be calibrated on a channel by channel basis or with the channels grouped together. Regardless of which option you choose, we recommend you calibrate all channels on your module each time you calibrate. This will help you maintain consistent calibration readings and improve module accuracy.

Calibration is meant to correct any hardware inaccuracies that may be present on a particular channel. The calibration procedure compares a known standard, either input signal or recorded output, with the channel's performance and then calculating a linear correction factor between the measured and the ideal.

The linear calibration correction factor is applied on every input or output same to obtain maximum accuracy.

Difference of Calibrating an Input Module and an Output Module

Although the purpose of calibrating analog modules is the same for input and output modules, to improve the module's accuracy and repeatability, the procedures involved differs for each.

- When you calibrate input modules, you use current, voltage, or ohms calibrators to send a signal to the module to calibrate it.
- When you calibrate output modules, you use a digital multimeter (DMM) to measure the signal the module is sending out.

To maintain your module's accuracy specifications, we recommend you use calibration instruments with specific ranges. The table lists the recommended instruments for each module.

Module	Recommended Instrument Range
1756-IF16 & 1756-IF8	0…10.25V source +/-150 µV voltage
1756-IF6CIS	1.00…20.00 mA source +/-0.15 µA current
1756-IF6I	0…10.00V source +/-150 µV voltage 1.00…20.00 mA source +/-0.15 µA current
1756-IR6I	1.0…487.0 Ω resistors(1) +/-0.01%
1756-IT6I & 1756-IT6I2	-12 mV…78 mV source +/-0.3 µV
1756-OF4 1756-OF8	DMM better than 0.3 mV or 0.6 µA
1756-OF6VI	DMM with resolution better than 0.5 µV
1756-OF6CI	DMM with resolution better than 1.0 µA

(1) We suggest you use these precision resistors.
KRL Electronics - 534A1-1R0T 1.0 Ohm 0.01% / 534A1-487R0T 487 Ohm 0.01%

A precision decade resistor box also can be used that meets or exceeds the required accuracy specifications. You are responsible for assuring that the decade box maintains accuracy by periodic calibration.

IMPORTANT Do not calibrate your module with an instrument that is less accurate than those recommended (for example, calibrate a 1756-IF16 module with a voltage calibrator of greater than +/-150 µV accuracy), to avoid anomalies.

- Calibration appears to occur normally but the module gives inaccurate data during operation.
- A calibration fault occurs, forcing you to abort calibration.
- The calibration fault bits are set for the channel you attempted to calibrate. The bits remain set until a valid calibration is completed.

In this case, you must recalibrate the module with an instrument as accurate as recommended.

Calibrating in Either Program or Run Mode

You must be online to calibrate your analog I/O modules by using RSLogix 5000 software. When you are online, you can choose either Program or Run mode as the state of your program during calibration.

We recommend that your module be in Program mode and not be actively controlling a process when you calibrate it.

IMPORTANT The module freezes the state of each channel and does not update the controller with new data until after the calibration ends. This could be hazardous if active control were attempted during calibration.

Calibrate Your Input Modules

Input calibration is a multi-step process that involves multiple services being sent to the module. This section has four parts as shown in the table. Each input module requires attention be paid to specific calibration ranges.

Topic	Page
Calibrating the 1756-IF16 or 1756-IF8 Modules	235
Calibrating the 1756-IF6CIS or 1756-IF6I Modules	241
Calibrating the 1756-IR6I	248
Calibrating the 1756-IT6I or 1756-IT6I2	253

Calibrating the 1756-IF16 or 1756-IF8 Modules

The 1756-IF16 or 1756-IF8 modules are used in applications requiring voltage or current. The modules offer four input ranges:

- -10…10V
- 0…5V
- 0…10V
- 0…20 mA

However, you can only calibrate these modules using a **voltage** signal.

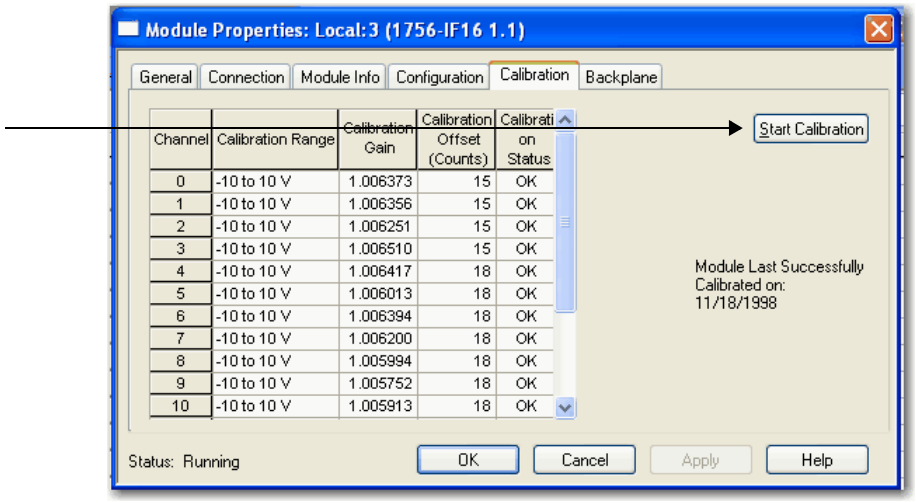
IMPORTANT Regardless of what application range is selected prior to calibration, all calibration uses a +/-10V range.

While you are online, you must access the Calibration tab on the Module Properties dialog box. See page 214 in Chapter 10 for procedures.

Follow these steps to calibrate your module.

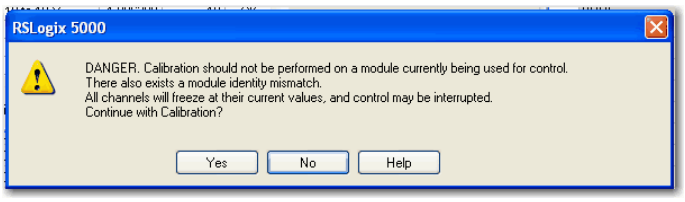
IMPORTANT The 1756-IF16 module is used in the screen facsimiles for the calibration process. However, the procedures are the same for the 1756-IF8 module.

1. Connect your voltage calibrator to the module.
2. Go to the Calibration tab on the Module Properties dialog box.

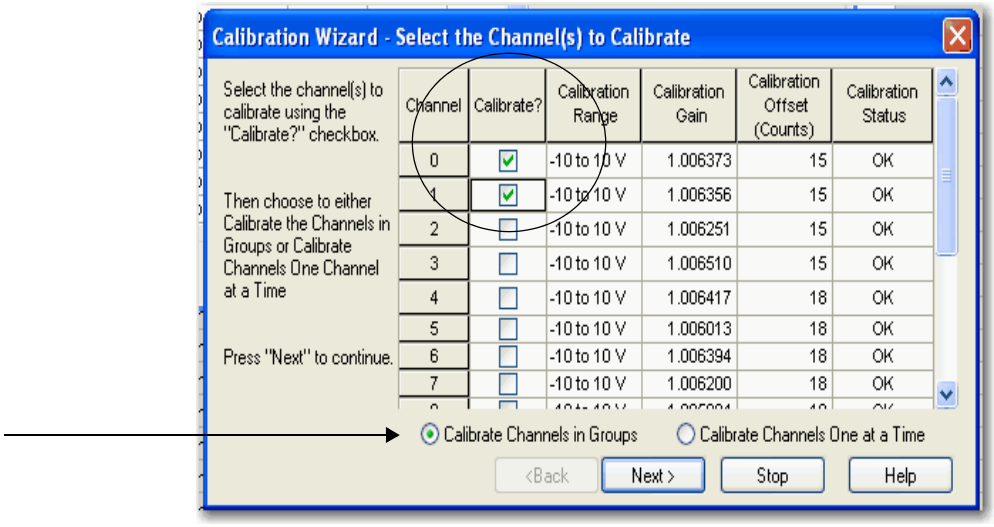

Module Properties: Local:3 (1756-IF16 1.1)
General
Connection
Module Info
Configuration
Calibration
Backplane
Channel
Calibration Range
Calibration Gain
Calibration Offset (Counts)
Calibration Status
0 -10 to 10 V 1.006373 15 OK
1 -10 to 10 V 1.006356 15 OK
2 -10 to 10 V 1.006251 15 OK
3 -10 to 10 V 1.006510 15 OK
4 -10 to 10 V 1.006417 18 OK
5 -10 to 10 V 1.006013 18 OK
6 -10 to 10 V 1.006394 18 OK
7 -10 to 10 V 1.006200 18 OK
8 -10 to 10 V 1.005994 18 OK
9 -10 to 10 V 1.005752 18 OK
10 -10 to 10 V 1.005913 18 OK
Start Calibration
Module Last Successfully Calibrated on: 11/18/1998
Status: Running
OK
Cancel
Apply
Help

3. Click Start Calibration to access the Calibration Wizard to step through the process.

   If your module is not in Program mode, a warning message appears. You must manually change the module to Program mode before clicking Yes.


RSLogix 5000
DANGER. Calibration should not be performed on a module currently being used for control.
There also exists a module identity mismatch.
All channels will freeze at their current values, and control may be interrupted.
Continue with Calibration?
Yes
No
Help

4. Set the channels to be calibrated.


Calibration Wizard - Select the Channel(s) to Calibrate
Select the channel(s) to calibrate using the "Calibrate?" checkbox.
Then choose to either Calibrate the Channels in Groups or Calibrate Channels One Channel at a Time
Press "Next" to continue.
Channel
Calibrate?
Calibration Range
Calibration Gain
Calibration Offset (Counts)
Calibration Status
0 -10 to 10 V 1.006373 15 OK
1 -10 to 10 V 1.006356 15 OK
2 -10 to 10 V 1.006251 15 OK
3 -10 to 10 V 1.006510 15 OK
4 -10 to 10 V 1.006417 18 OK
5 -10 to 10 V 1.006013 18 OK
6 -10 to 10 V 1.006394 18 OK
7 -10 to 10 V 1.006200 18 OK
Calibrate Channels in Groups
Calibrate Channels One at a Time
<Back
Next >
Stop
Help

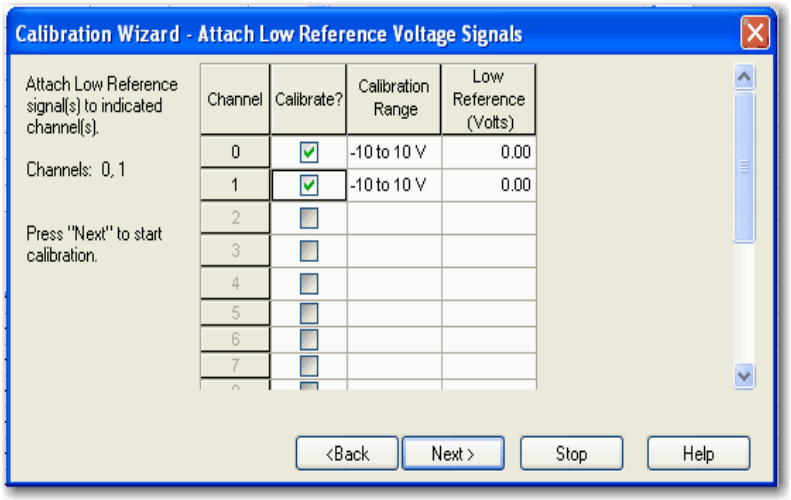
TIP

You can select whether to calibrate channels in groups all at once or each channel at a time. The example above shows channels 0,1 being calibrated at the same time for instructional purposes.

We recommend you calibrate all channels on your module each time you calibrate. This will help you maintain consistent calibration readings and improve module accuracy.

5. Click Next.

The Low Reference Voltage Signals wizard appears to show which channels will be calibrated for a low reference and the range of the calibration. It also shows what reference signal is expected at the input.

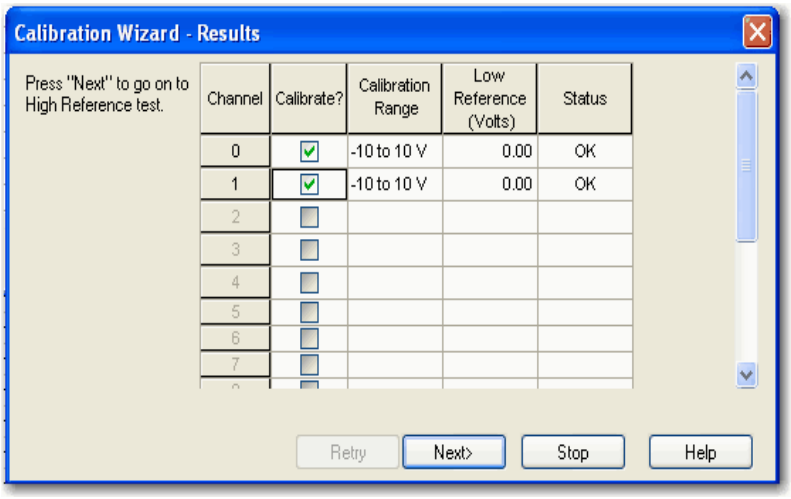


6. Click Next.

TIP Click Back to return to the last window to make any necessary changes. Click Stop to halt the calibration process, if necessary.

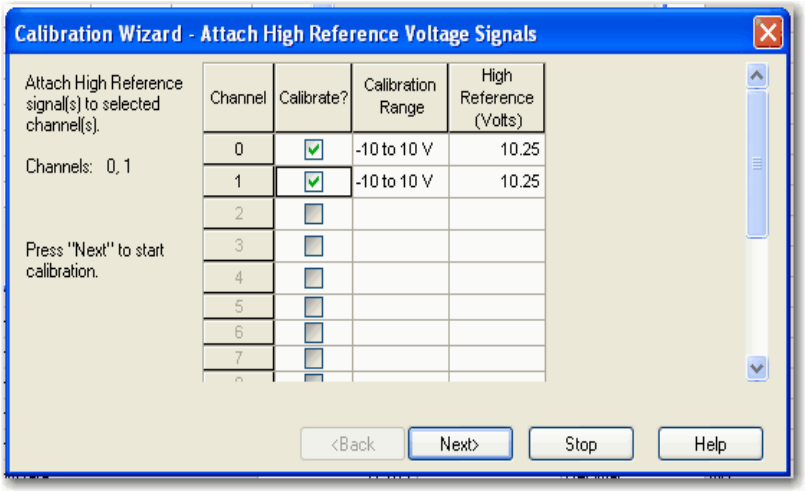
7. Set the calibrator for the low reference and apply it to the module.

   A Results wizard displays the status of each channel after calibrating for a low reference. If channels are OK, continue. If any channel reports an error, retry step 7 until the status is OK.



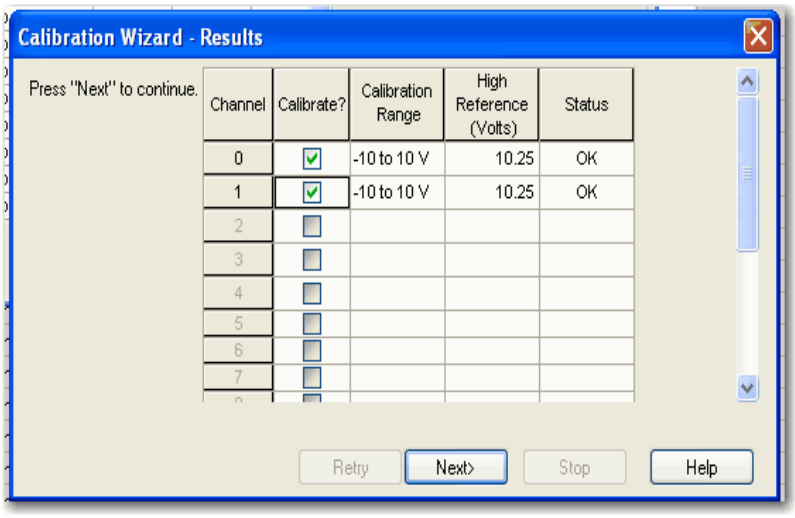
8. Set the calibrator for the high reference voltage and apply it to the module.

   The High Reference Voltage Signals wizard appears to show which channels will be calibrated for a high reference and the range of the calibration. It also shows what reference signal is expected at the input.

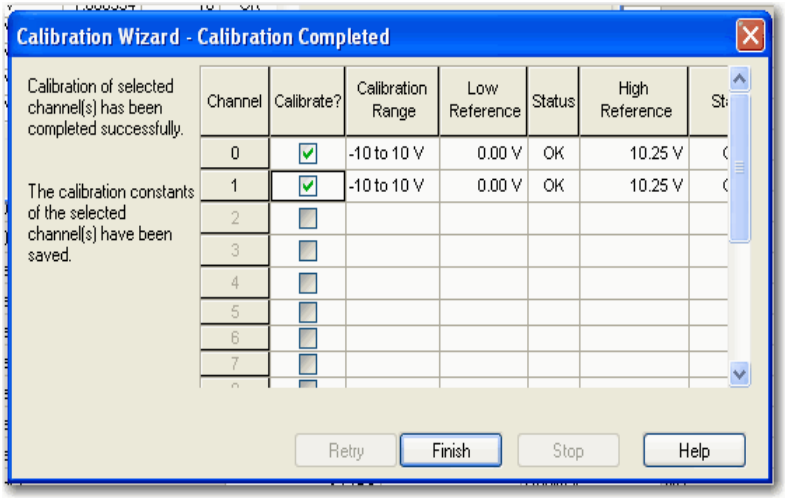


9. Click Next.

A Results wizard displays the status of each channel after calibrating for a high reference. If channels are OK, continue. If any channel reports an error, retry step 8 until the status is OK.



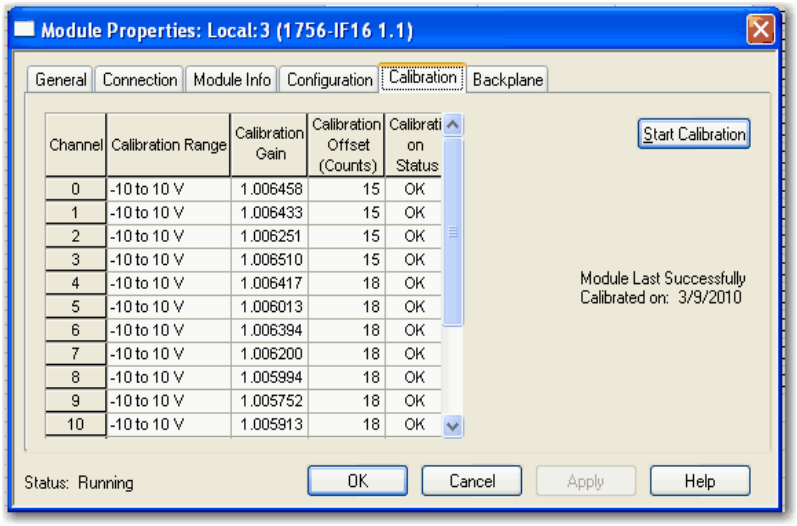
After you have completed both low and high reference calibration, this window shows the status of both.



10. Click Finish.

The Calibration tab on the Module Properties dialog box shows the changes in the Calibration Gain and Calibration Offset.

The date of the latest calibration also displays.


Module Properties: Local:3 (1756-IF16 1.1)
General
Connection
Module Info
Configuration
Calibration
Backplane
Channel
Calibration Range
Calibration Gain
Calibration Offset (Counts)
Calibration Status
0 -10 to 10 V 1.006458 15 OK
1 -10 to 10 V 1.006433 15 OK
2 -10 to 10 V 1.006251 15 OK
3 -10 to 10 V 1.006510 15 OK
4 -10 to 10 V 1.006417 18 OK
5 -10 to 10 V 1.006013 18 OK
6 -10 to 10 V 1.006394 18 OK
7 -10 to 10 V 1.006200 18 OK
8 -10 to 10 V 1.005994 18 OK
9 -10 to 10 V 1.005752 18 OK
10 -10 to 10 V 1.005913 18 OK
Start Calibration
Module Last Successfully Calibrated on: 3/9/2010
Status: Running
OK
Cancel
Apply
Help

11. Click OK.

Calibrating the 1756-IF6CIS or 1756-IF6I Modules

The 1756-IF6CIS module can be used for applications that require current only. The 1756-IF6I module can be used for applications requiring voltage or current. Calibrate the modules for your specific application.

Calibrating the 1756-IF6I for Voltage Applications

During 1756-IF6I module calibration, 0.0V and +10.0V external references are applied consecutively to the module's terminals. The module records the deviation from these reference values (that is, 0.0V and +10.0V) and stores it as calibration constants in the module's firmware. The internal calibration constants are then used in every subsequent signal conversion to compensate for circuit inaccuracies. The 0/10V user calibration compensates for all voltage ranges on the 1756-IF6I module (0-10V, +/-10V, and 0-5V) and compensates for inaccuracies of the module's entire analog circuitry, including input amplifier, resistors, and the A/D convertor.

The 1756-IF6I offers 3 input voltage ranges:

- -10…10V
- 0…5V
- 0…10V

IMPORTANT Regardless of what voltage application range is selected prior to calibration, all voltage calibration uses a +/-10V range.

Calibrating the 1756-IF6CIS or 1756-IF6I for Current Applications

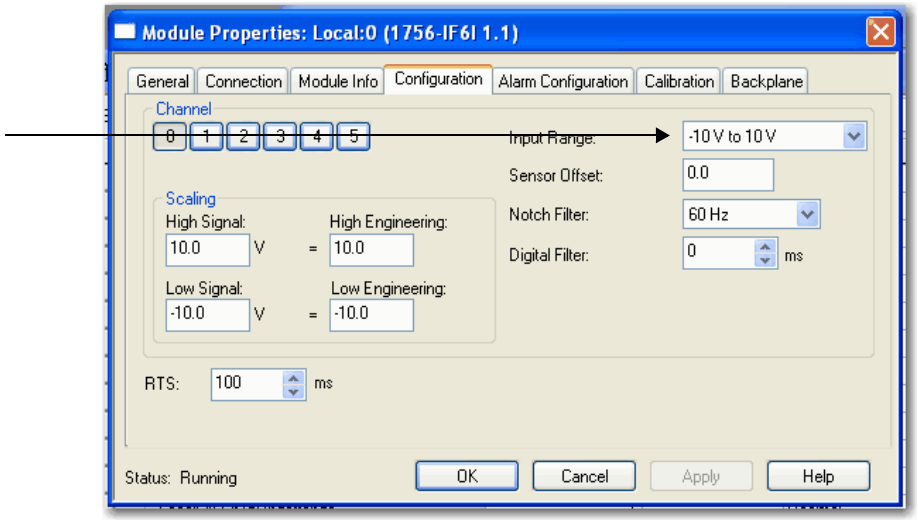
The 1756-IF6CIS and 1756-IF6I modules offer a 0…20 mA current range. Calibrating the modules for current uses the same process as calibrating the 1756-IF6I for voltage except the change in input signal.

While you are online, you must access the Module Properties dialog box. See page 207 in Chapter 10 for procedures.

Follow these steps to calibrate your module.

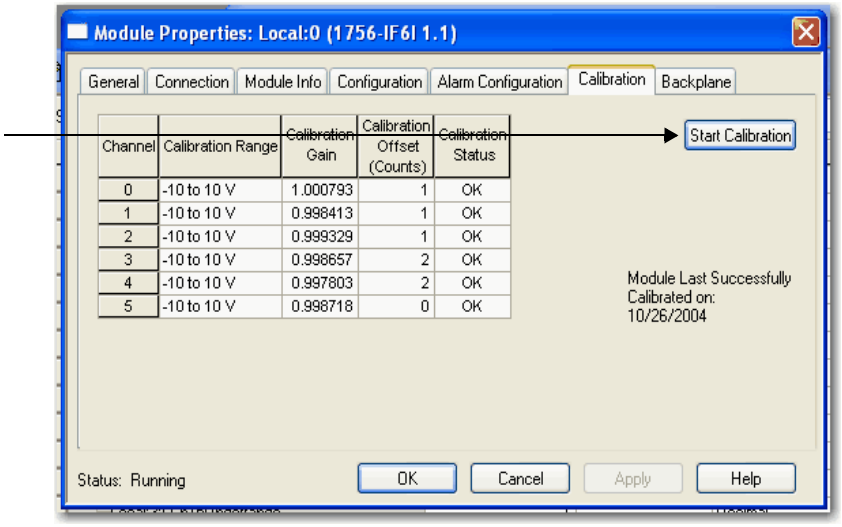
IMPORTANT The following examples show how you calibrate the 1756-IF6I module for voltage. Calibrating the modules for current uses the same process as calibrating the 1756-IF6I module for voltage except the change in input signal.

1. Connect your voltage calibrator to the module.
2. Go to the Configuration tab on the Module Properties dialog box.



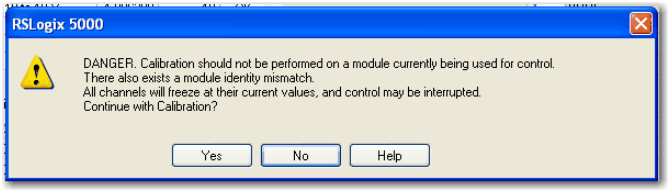
3. At the Input Range, choose the range from the pull-down menu to calibrate the channels.
4. Click OK.

5. Click the Calibration Tab on the Module Properties dialog box.

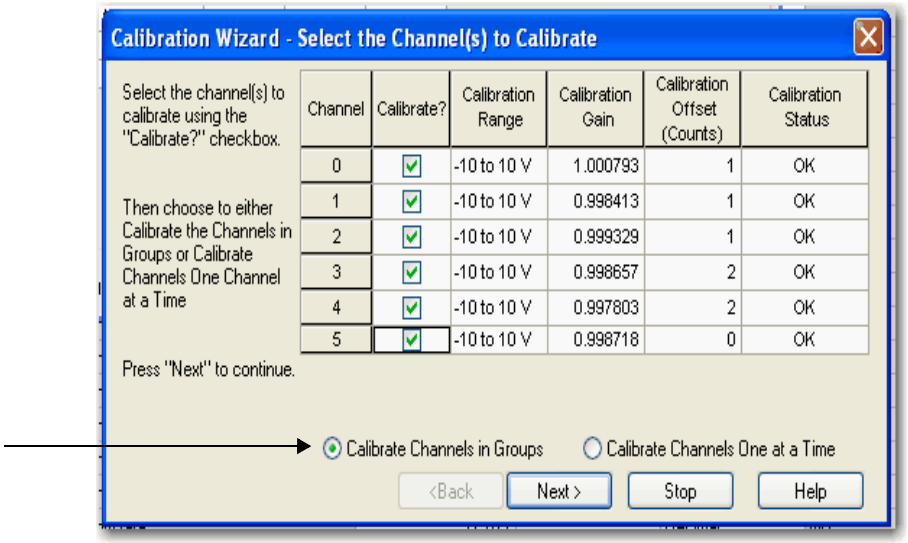


6. Click Start Calibration to access the Calibration Wizard to step through the process.

   If your module is not in Program mode, a warning message appears. You must manually change the module to Program mode before clicking Yes.


RSLogix 5000
DANGER. Calibration should not be performed on a module currently being used for control.
There also exists a module identity mismatch.
All channels will freeze at their current values, and control may be interrupted.
Continue with Calibration?
Yes
No
Help

7. Set the channels to be calibrated.


Calibration Wizard - Select the Channel(s) to Calibrate
Select the channel(s) to calibrate using the "Calibrate?" checkbox.
Then choose to either Calibrate the Channels in Groups or Calibrate Channels One Channel at a Time
Press "Next" to continue.
Channel
Calibrate?
Calibration Range
Calibration Gain
Calibration Offset (Counts)
Calibration Status
0 -10 to 10 V 1.000793 1 OK
1 -10 to 10 V 0.998413 1 OK
2 -10 to 10 V 0.999329 1 OK
3 -10 to 10 V 0.998657 2 OK
4 -10 to 10 V 0.997803 2 OK
5 -10 to 10 V 0.998718 0 OK
Calibrate Channels in Groups
Calibrate Channels One at a Time
<Back
Next >
Stop
Help

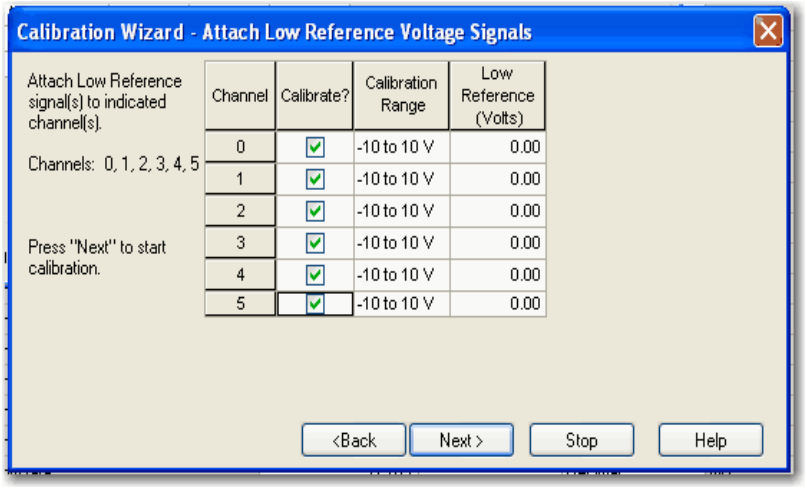
TIP

You can select whether to calibrate channels in groups all at once or each channel at a time. The example above shows all channels will be calibrated at the same time.

We recommend you calibrate all channels on your module each time you calibrate. This will help you maintain consistent calibration readings and improve module accuracy.

8. Click Next.

The Low Reference Voltage Signals wizard appears to show which channels will be calibrated for a low reference and the range of the calibration. It also shows what reference signal is expected at the input.


Calibration Wizard - Attach Low Reference Voltage Signals
Attach Low Reference signal(s) to indicated channel(s).
Channels: 0, 1, 2, 3, 4, 5
Press "Next" to start calibration.
Channel
Calibrate?
Calibration Range
Low Reference (Volts)
0 -10 to 10 V 0.00
1 -10 to 10 V 0.00
2 -10 to 10 V 0.00
3 -10 to 10 V 0.00
4 -10 to 10 V 0.00
5 -10 to 10 V 0.00
<Back
Next >
Stop
Help

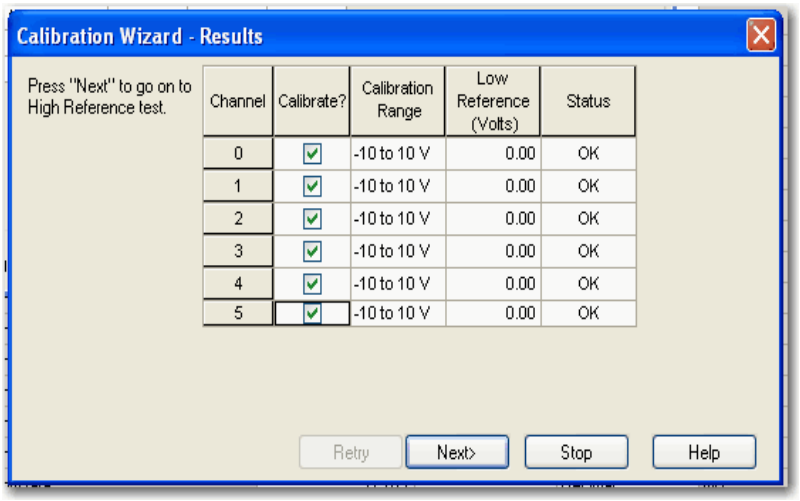
9. Click Next.

TIP

Click Back to return to the last window to make any necessary changes. Click Stop to halt the calibration process, if necessary.

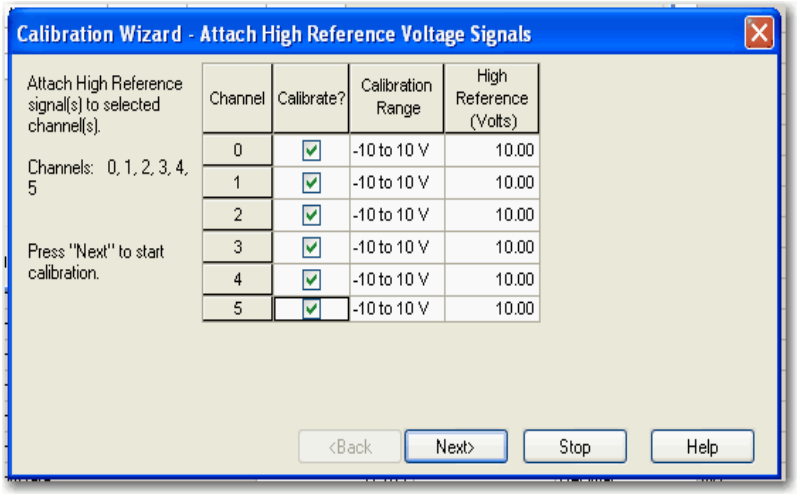
10. Set the calibrator for the low reference and apply it to the module.

A Results wizard displays the status of each channel after calibrating for a low reference. If channels are OK, continue. If any channel reports an error, retry step 10 until the status is OK.



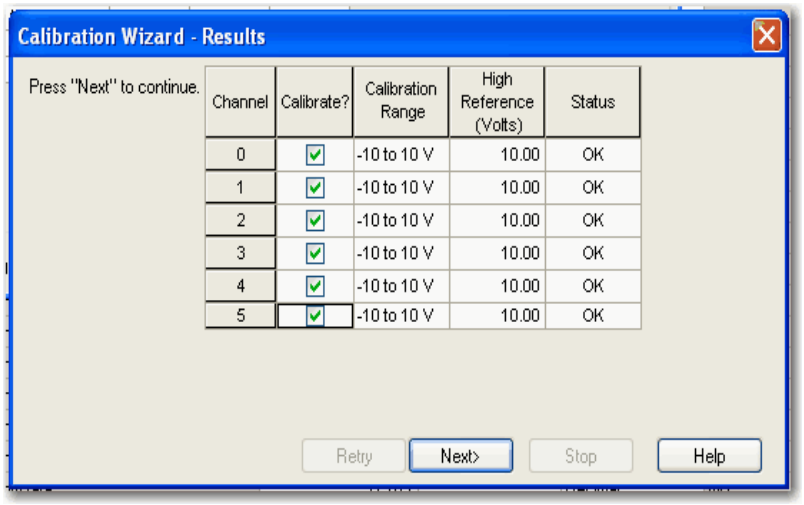
11. Set the calibrator for the high reference voltage and apply it to the module.

The High Reference Voltage Signals wizard appears to show which channels will be calibrated for a high reference and the range of the calibration. It also shows what reference signal is expected at the input.

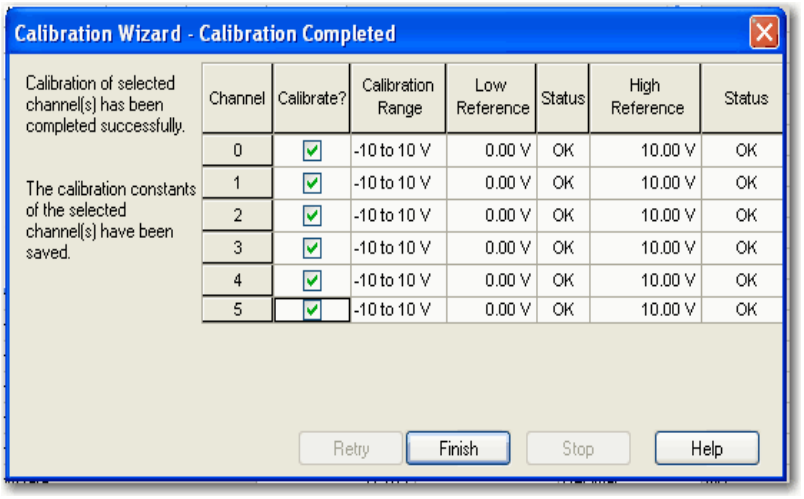

Calibration Wizard - Attach High Reference Voltage Signals
Attach High Reference signal(s) to selected channel(s).
Channels: 0, 1, 2, 3, 4, 5
Press "Next" to start calibration.
Channel
Calibrate?
Calibration Range
High Reference (Volts)
0 -10 to 10 V 10.00
1 -10 to 10 V 10.00
2 -10 to 10 V 10.00
3 -10 to 10 V 10.00
4 -10 to 10 V 10.00
5 -10 to 10 V 10.00
<Back
Next>
Stop
Help

12. Click Next.

A Results wizard displays the status of each channel after calibrating for a high reference. If channels are OK, continue. If any channels report an error, retry step 11 until the status is OK.

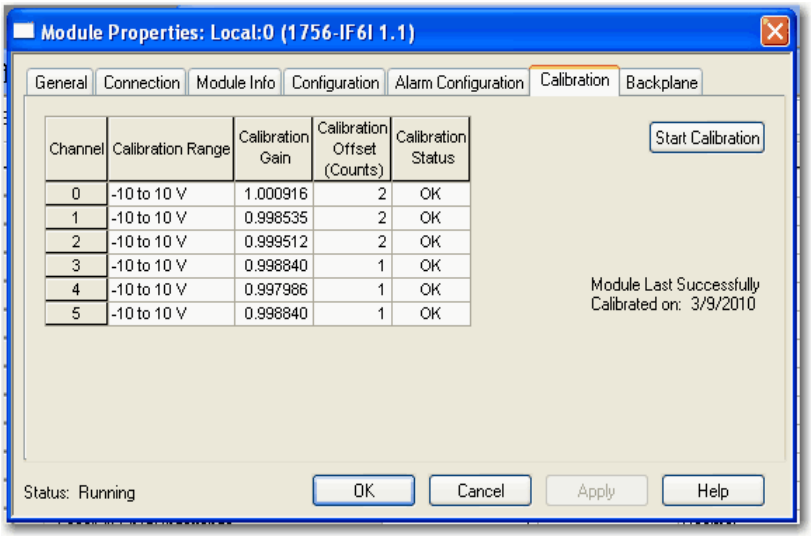


After you have completed both low and high reference calibration, this window shows the status of both.


Calibration Wizard - Calibration Completed
Calibration of selected channel(s) has been completed successfully.
The calibration constants of the selected channel(s) have been saved.
Channel
Calibrate?
Calibration Range
Low Reference
Status
High Reference
Status
0 -10 to 10 V 0.00 V OK 10.00 V OK
1 -10 to 10 V 0.00 V OK 10.00 V OK
2 -10 to 10 V 0.00 V OK 10.00 V OK
3 -10 to 10 V 0.00 V OK 10.00 V OK
4 -10 to 10 V 0.00 V OK 10.00 V OK
5 -10 to 10 V 0.00 V OK 10.00 V OK
Retry
Finish
Stop
Help

13. Click Finish.

The Calibration tab on the Module Properties dialog box shows the changes in the Calibration Gain and Calibration Offset. The date of the latest calibration also displays.



14. Click OK.

Calibrating the 1756-IR6I

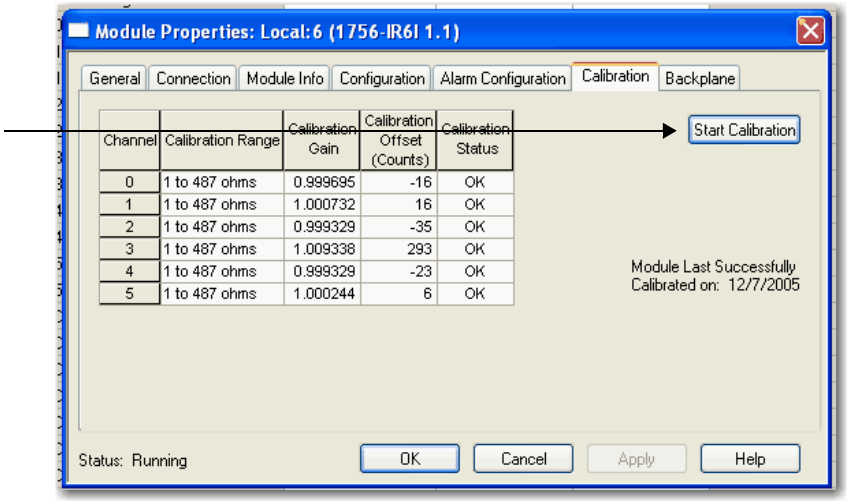
This module does not calibrate for voltage or current. It uses two precision resistors to calibrate the channels in ohms. You must connect a 1 Ω precision resistor for low reference calibration and a 487 Ω precision resistor for high reference calibration. The 1756-IR6I only calibrates in the 1…487 Ω range.

IMPORTANT When you are wiring precision resistors for calibration, follow the wiring example on page 138. Make sure terminals IN-x/B and RTN-x/C are shorted together at the RTB.

While you are online, you must access the Calibration tab on the Module Properties dialog box. See page 214 in Chapter 10 for procedures.

Follow these steps to calibrate your module.

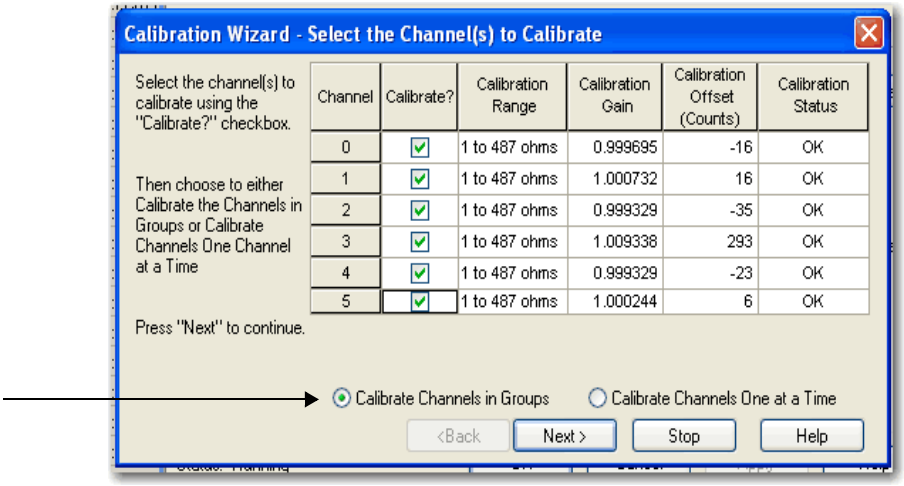
1. Go to the Calibration Tab on the Module Properties dialog box.



2. Click Start Calibration to access the Calibration Wizard to step through the process.

IMPORTANT Regardless of what ohms application range is selected prior to calibration, the 1756-IR6I only calibrates in the 1…487 Ω range.

3. Set the channels to be calibrated.


Calibration Wizard - Select the Channel(s) to Calibrate
Select the channel(s) to calibrate using the "Calibrate?" checkbox.
Then choose to either Calibrate the Channels in Groups or Calibrate Channels One Channel at a Time
Press "Next" to continue.
Channel
Calibrate?
Calibration Range
Calibration Gain
Calibration Offset (Counts)
Calibration Status
0 1 to 487 ohms 0.999695 -16 OK
1 1 to 487 ohms 1.000732 16 OK
2 1 to 487 ohms 0.999329 -35 OK
3 1 to 487 ohms 1.009338 293 OK
4 1 to 487 ohms 0.999329 -23 OK
5 1 to 487 ohms 1.000244 6 OK
Calibrate Channels in Groups
Calibrate Channels One at a Time
<Back
Next >
Stop
Help

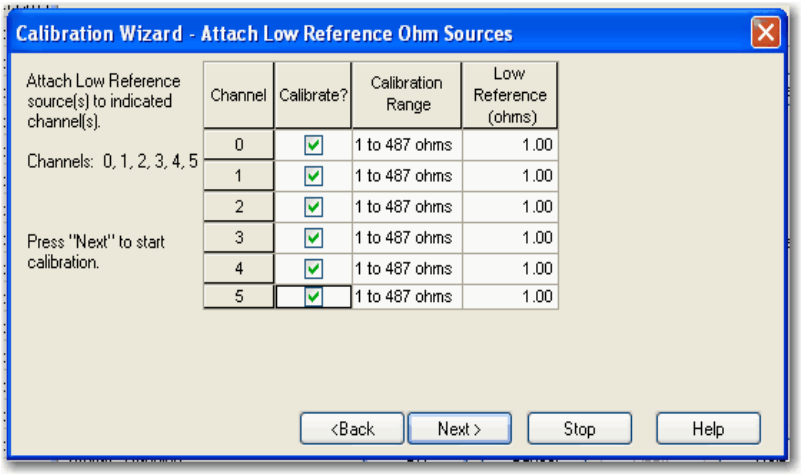
TIP

You can select whether to calibrate channels in groups all at once or each channel at a time. The example above shows all channels will be calibrated at the same time.

We recommend you calibrate all channels on your module each time you calibrate. This will help you maintain consistent calibration readings and improve module accuracy.

4. Click Next.

The Low Reference Ohm Sources wizard appears to show which channels will be calibrated for a low reference and the range of the calibration. It also shows what reference signal is expected at the input.


Calibration Wizard - Attach Low Reference Ohm Sources
Attach Low Reference source(s) to indicated channel(s).
Channels: 0, 1, 2, 3, 4, 5
Press "Next" to start calibration.
Channel
Calibrate?
Calibration Range
Low Reference (ohms)
0 1 to 487 ohms 1.00
1 1 to 487 ohms 1.00
2 1 to 487 ohms 1.00
3 1 to 487 ohms 1.00
4 1 to 487 ohms 1.00
5 1 to 487 ohms 1.00
<Back
Next >
Stop
Help

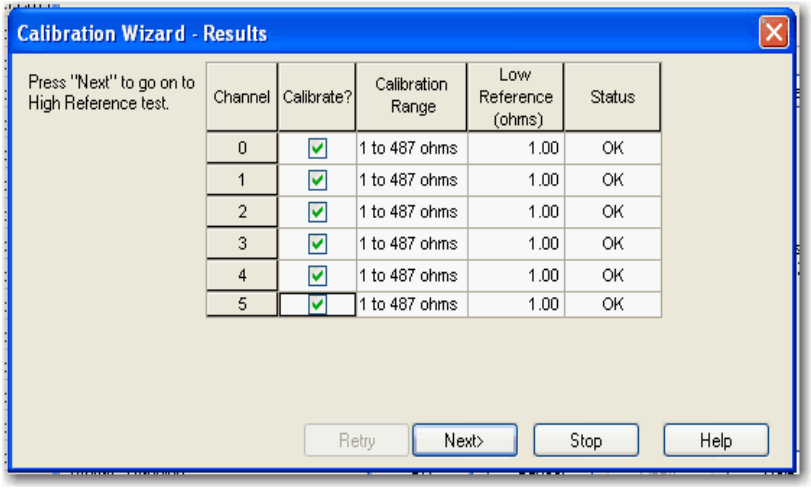
5. Click Next.

TIP

Click Back to return to the last window to make any necessary changes. Click Stop to halt the calibration process, if necessary.

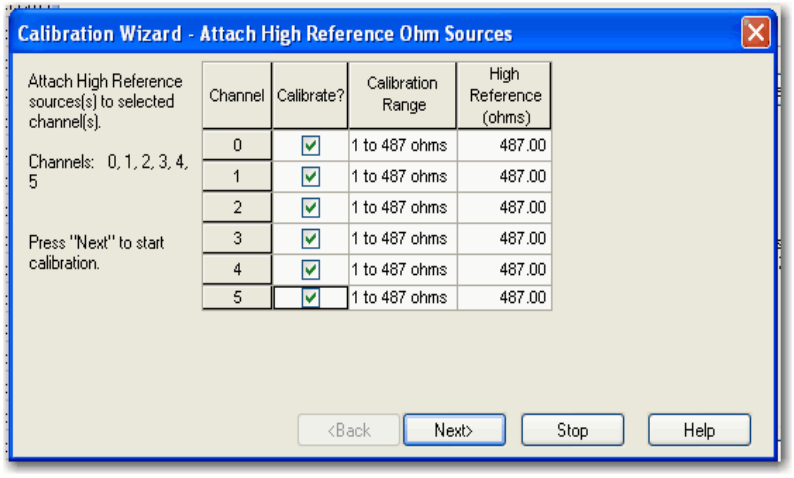
6. Connect a 1 Ω resistor to each channel being calibrated.

   A Results wizard displays the status of each channel after calibrating for a low reference. If channels are OK, continue. If any channel reports an error, retry step 6 until the status is OK.



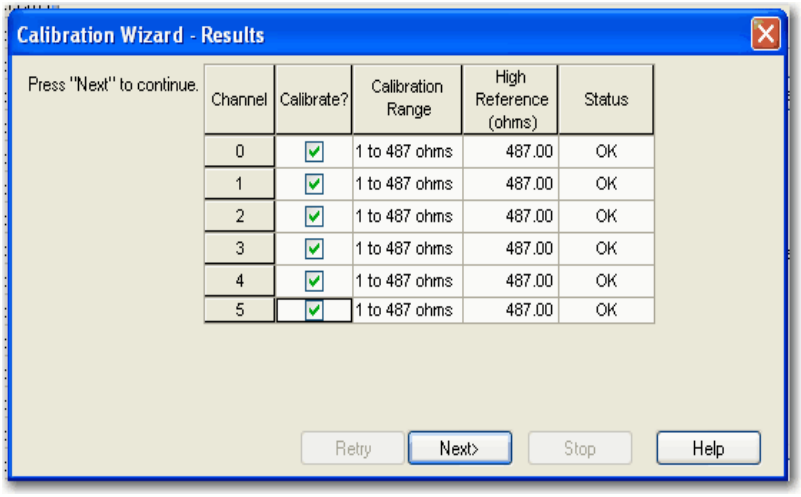
7. Connect a 487 Ω resistor to each channel being calibrated.

   The High Reference Ohm Sources wizard appears to show which channels will be calibrated for a high reference and the range of the calibration. It also shows what reference signal is expected at the input.

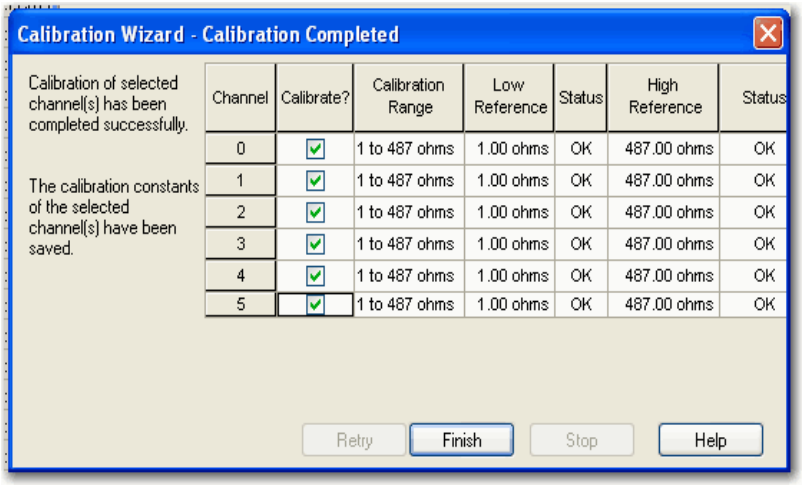

Calibration Wizard - Attach High Reference Ohm Sources
Attach High Reference sources(s) to selected channel(s).
Channels: 0, 1, 2, 3, 4, 5
Press "Next" to start calibration.
Channel
Calibrate?
Calibration Range
High Reference (ohms)
0 1 to 487 ohms 487.00
1 1 to 487 ohms 487.00
2 1 to 487 ohms 487.00
3 1 to 487 ohms 487.00
4 1 to 487 ohms 487.00
5 1 to 487 ohms 487.00
<Back
Next>
Stop
Help

8. Click Next.

A Results wizard displays the status of each channel after calibrating for a high reference. If channels are OK, continue. If any channels report an error, retry step 7 until the status is OK.

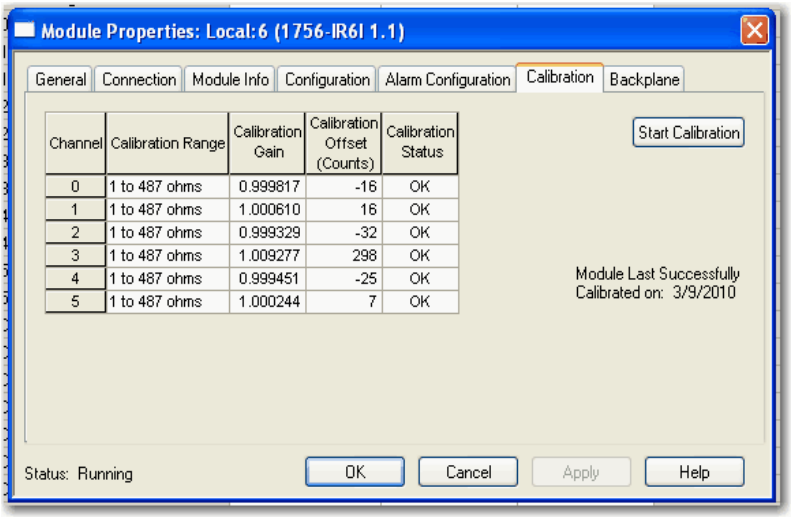


After you have completed both low and high reference calibration, this window shows the status of both.


Calibration Wizard - Calibration Completed
Calibration of selected channel(s) has been completed successfully.
The calibration constants of the selected channel(s) have been saved.
Channel
Calibrate?
Calibration Range
Low Reference
Status
High Reference
Status
0 1 to 487 ohms 1.00 ohms OK 487.00 ohms OK
1 1 to 487 ohms 1.00 ohms OK 487.00 ohms OK
2 1 to 487 ohms 1.00 ohms OK 487.00 ohms OK
3 1 to 487 ohms 1.00 ohms OK 487.00 ohms OK
4 1 to 487 ohms 1.00 ohms OK 487.00 ohms OK
5 1 to 487 ohms 1.00 ohms OK 487.00 ohms OK
Retry
Finish
Stop
Help

9. Click Finish.

The Calibration tab on the Module Properties dialog box shows the changes in the Calibration Gain and Calibration Offset. The date of the latest calibration also displays.



10. Click OK.

Calibrating the 1756-IT6I or 1756-IT6I2

This module only calibrates in millivolts. You can calibrate the module to either a -12…+30 mV range or -12…+78 mV range, depending upon your specific application.

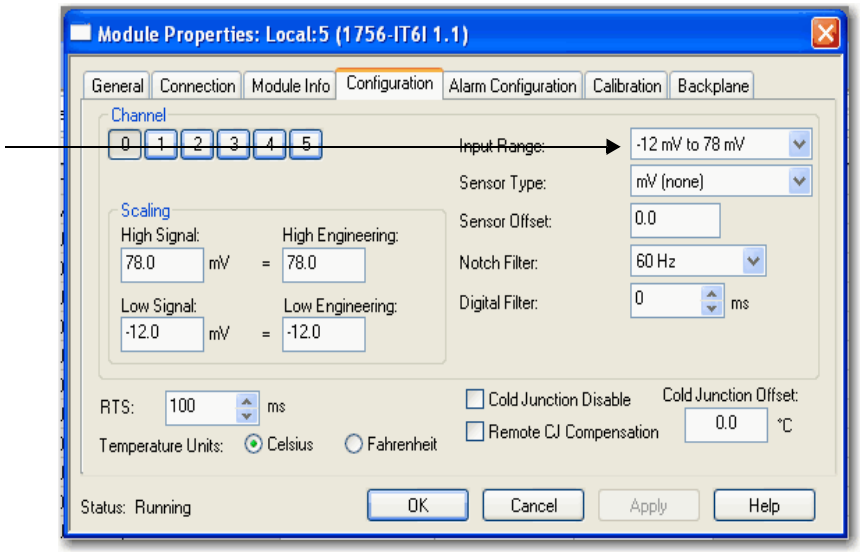
IMPORTANT The following examples show a 1756-IT6I module being calibrated for a -12 mV…+78 mV range. The same procedures apply for a 1756-IT6I2 module.

You also use the same steps to calibrate for a -12 mV…+30 mV range.

While you are online, you must access the Module Properties dialog box. See page 207 in Chapter 10 for procedures.

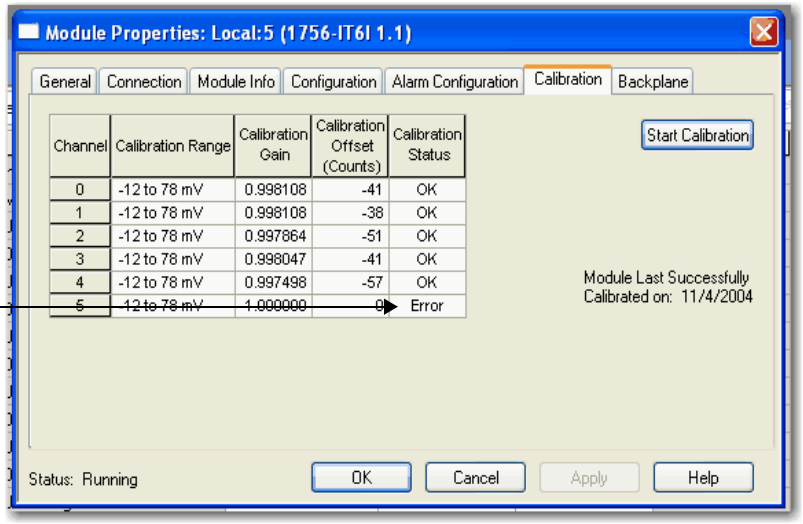
Follow these steps to calibrate your module.

1. Connect your voltage calibrator to the module.
2. Go to the Configuration tab on the Module Properties dialog box.



3. At the Input Range, choose the range from the pull-down menu to calibrate the channels.
4. Click OK.

5. Click the Calibration Tab on the Module Properties dialog box.

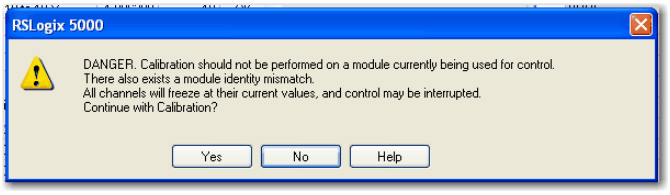


IMPORTANT The 'Error' for channel 5 shows that during the previous calibration the process was not successful for this particular channel. We suggest a valid calibration be performed for all channels.

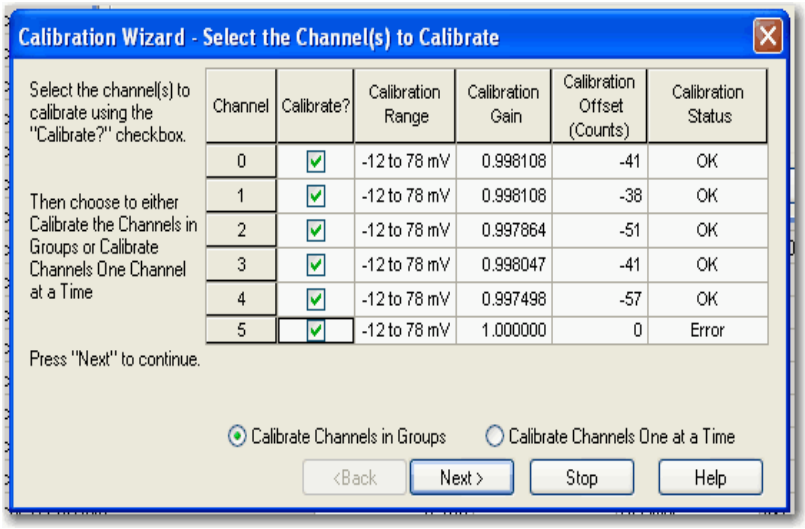
See page 258 for a successful calibration status.

6. Click Start Calibration to access the Calibration Wizard to step through the process.

   If your module is not in Program mode, a warning message appears. You must manually change the module to Program mode before clicking Yes.


RSLogix 5000
DANGER. Calibration should not be performed on a module currently being used for control.
There also exists a module identity mismatch.
All channels will freeze at their current values, and control may be interrupted.
Continue with Calibration?
Yes
No
Help

7. Set the channels to be calibrated.


Calibration Wizard - Select the Channel(s) to Calibrate
Select the channel(s) to calibrate using the "Calibrate?" checkbox.
Then choose to either Calibrate the Channels in Groups or Calibrate Channels One Channel at a Time
Press "Next" to continue.
Channel
Calibrate?
Calibration Range
Calibration Gain
Calibration Offset (Counts)
Calibration Status
0 -12 to 78 mV 0.998108 -41 OK
1 -12 to 78 mV 0.998108 -38 OK
2 -12 to 78 mV 0.997864 -51 OK
3 -12 to 78 mV 0.998047 -41 OK
4 -12 to 78 mV 0.997498 -57 OK
5 -12 to 78 mV 1.000000 0 Error
Calibrate Channels in Groups
Calibrate Channels One at a Time
<Back
Next >
Stop
Help

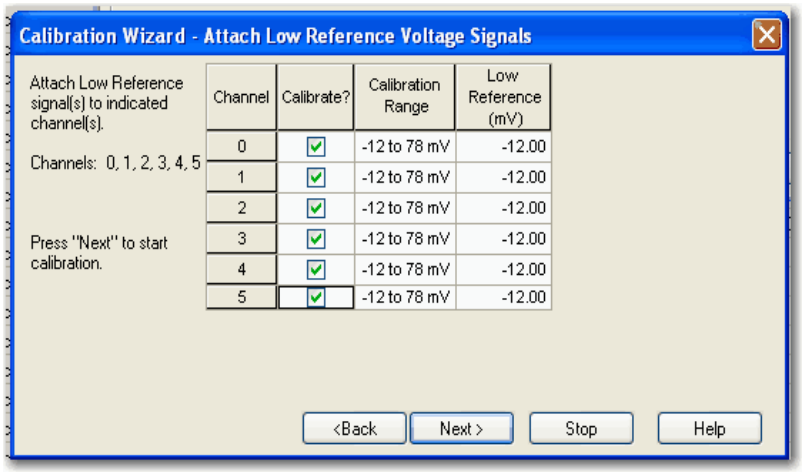
TIP

You can select whether to calibrate channels in groups all at once or each channel at a time. The example above shows all channels will be calibrated at the same time.

We recommend you calibrate all channels on your module each time you calibrate. This will help you maintain consistent calibration readings and improve module accuracy.

8. Click Next.

The Low Reference Voltage Signals wizard appears to show which channels will be calibrated for a low reference and the range of the calibration. It also shows what reference signal is expected at the input.


Calibration Wizard - Attach Low Reference Voltage Signals
Attach Low Reference signal(s) to indicated channel(s).
Channels: 0, 1, 2, 3, 4, 5
Press "Next" to start calibration.
Channel
Calibrate?
Calibration Range
Low Reference (mV)
0 -12 to 78 mV -12.00
1 -12 to 78 mV -12.00
2 -12 to 78 mV -12.00
3 -12 to 78 mV -12.00
4 -12 to 78 mV -12.00
5 -12 to 78 mV -12.00
<Back
Next >
Stop
Help

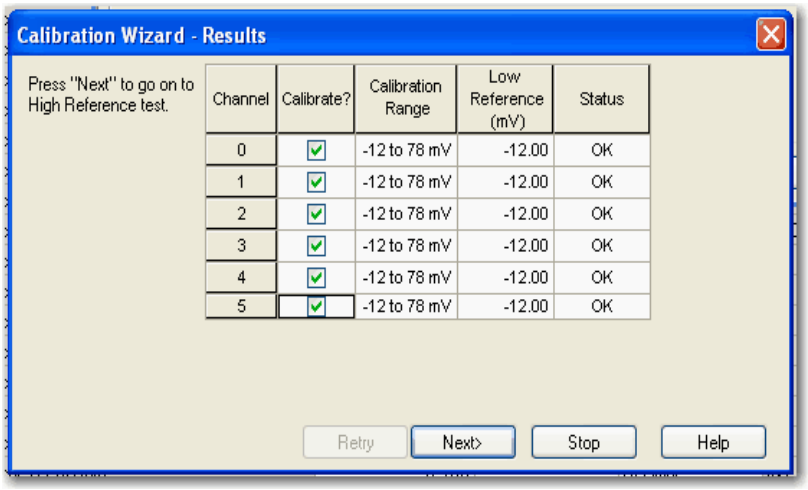
9. Click Next.

TIP

Click Back to return to the last window to make any necessary changes. Click Stop to halt the calibration process, if necessary.

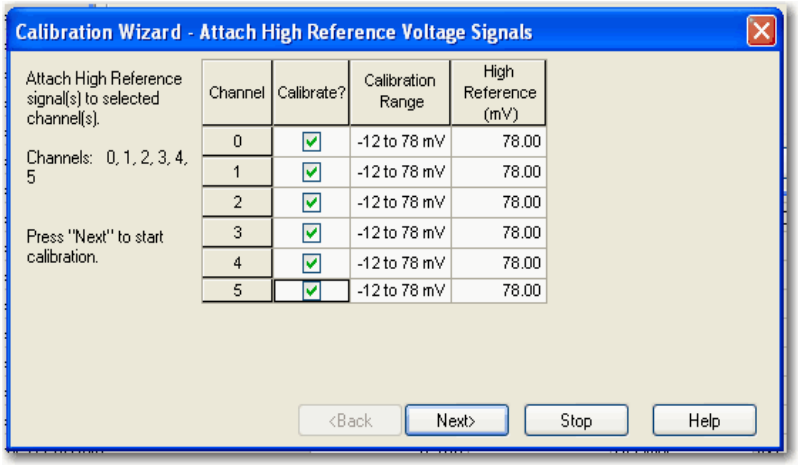
10. Set the calibrator for the low reference and apply it to the module.

    A Results wizard displays the status of each channel after calibrating for a low reference. If channels are OK, continue. If any channel reports an error, retry step 10 until the status is OK.



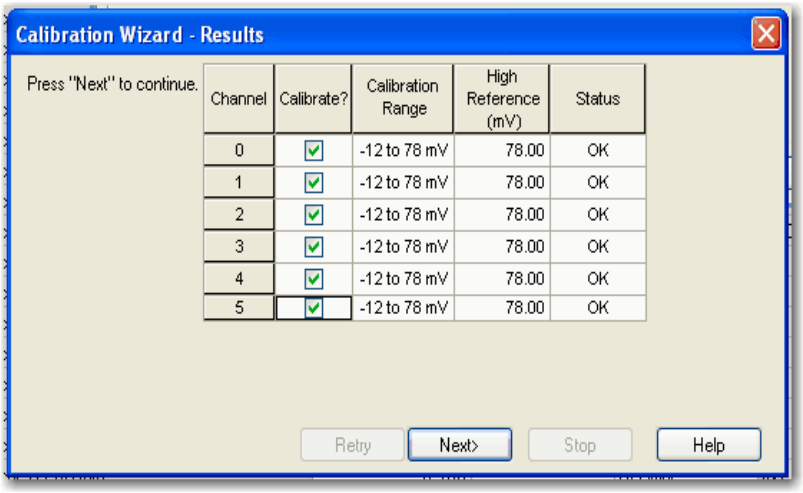
11. Set the calibrator for the high reference voltage and apply it to the module.

    The High Reference Voltage Signals wizard appears to show which channels will be calibrated for a high reference and the range of the calibration. It also shows what reference signal is expected at the input.

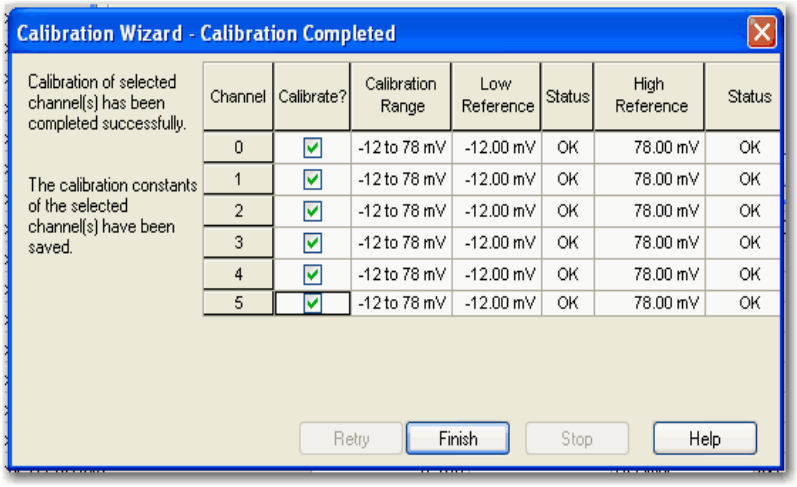

Calibration Wizard - Attach High Reference Voltage Signals
Attach High Reference signal(s) to selected channel(s).
Channels: 0, 1, 2, 3, 4, 5
Press "Next" to start calibration.
Channel
Calibrate?
Calibration Range
High Reference (mV)
0 -12 to 78 mV 78.00
1 -12 to 78 mV 78.00
2 -12 to 78 mV 78.00
3 -12 to 78 mV 78.00
4 -12 to 78 mV 78.00
5 -12 to 78 mV 78.00
<Back
Next>
Stop
Help

12. Click Next.

A Results wizard displays the status of each channel after calibrating for a high reference. If channels are OK, continue. If any channels report an error, retry step 11 until the status is OK.

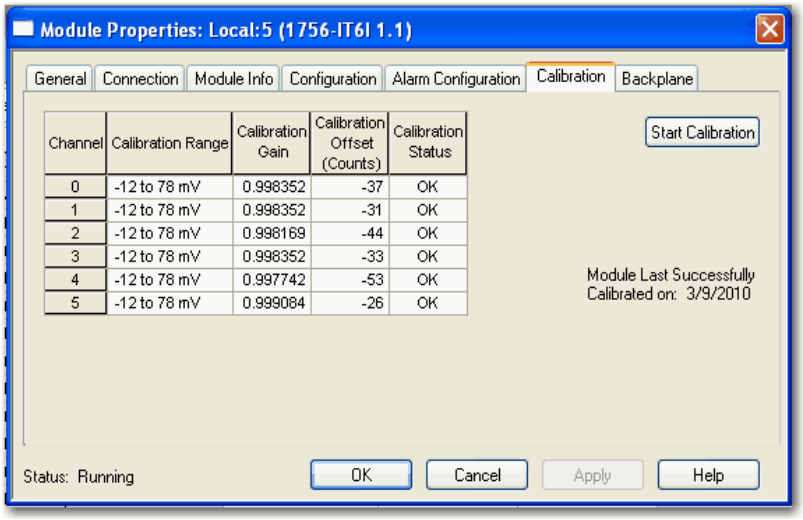


After you have completed both low and high reference calibration, this window shows the status of both.


Calibration Wizard - Calibration Completed
Calibration of selected channel(s) has been completed successfully.
The calibration constants of the selected channel(s) have been saved.
Channel
Calibrate?
Calibration Range
Low Reference
Status
High Reference
Status
0 -12 to 78 mV -12.00 mV OK 78.00 mV OK
1 -12 to 78 mV -12.00 mV OK 78.00 mV OK
2 -12 to 78 mV -12.00 mV OK 78.00 mV OK
3 -12 to 78 mV -12.00 mV OK 78.00 mV OK
4 -12 to 78 mV -12.00 mV OK 78.00 mV OK
5 -12 to 78 mV -12.00 mV OK 78.00 mV OK
Retry
Finish
Stop
Help

13. Click Finish.

The Calibration tab on the Module Properties dialog box shows the changes in the Calibration Gain and Calibration Offset. The date of the latest calibration also displays.



14. Click OK.

Calibrate Your Output Modules

Output calibration is a multi-step process that involves measuring a signal from the module. This section has two parts, as shown in the table.

Topic	Page
Current Meter Calibrations	259
Voltage Meter Calibrations	266

The 1756-OF4 and 1756-OF8 modules can be calibrated for current or voltage applications.

The 1756-OF6CI module, however, must be calibrated for current only, while the OF6VI must be calibrated specifically for voltage.

Current Meter Calibrations

RSLogix 5000 software commands the module to output specific levels of current. You must measure the actual level and record the results. This measurement allows the module to account for any inaccuracies.

The 1756-OF4, 1756-OF8, and 1756-OF6CI modules use basically the same procedures for being calibrated by a current meter.

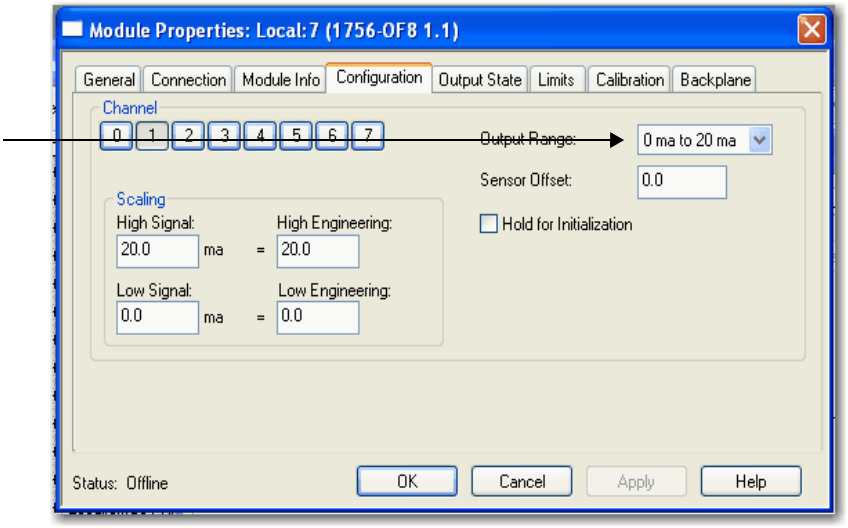
While you are online, you must access the Module Properties dialog box. See page 207 in Chapter 10 for procedures.

Follow these steps to calibrate your module.

1. Connect your current meter to the module.

   For the 1756-OF4 and 1756-OF8 modules, do additional steps 2…4. For the 1756-OF6CI module, go to step 5.

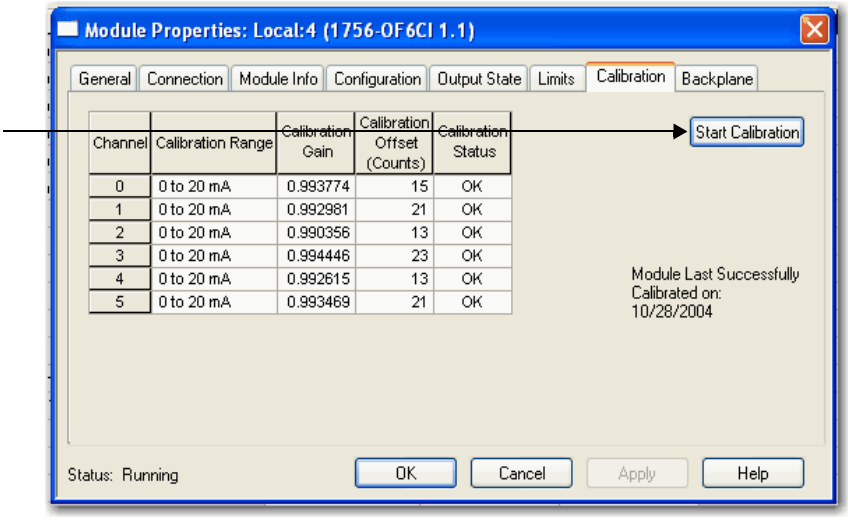
2. Go to the Configuration tab on the Module Properties dialog box.



3. At the Output Range, choose the range from the pull-down menu to calibrate the channels.

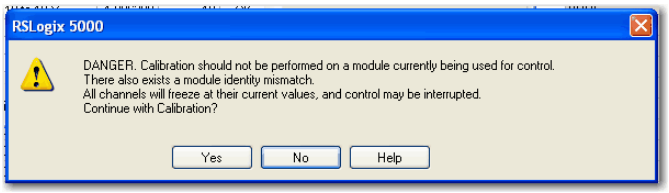
4. Click OK.

5. Click the Calibration Tab on the Module Properties dialog box.

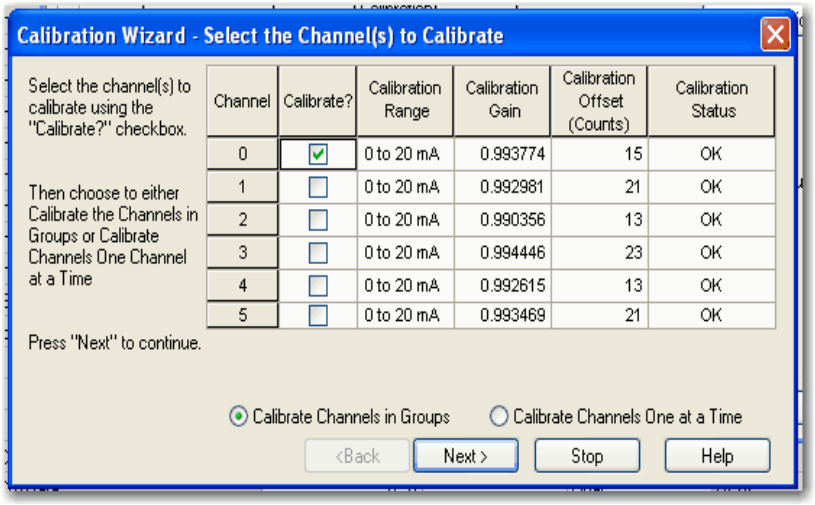


6. Click Start Calibration to access the Calibration Wizard to step through the process.

If your module is not in Program mode, a warning message appears. You must manually change the module to Program mode before clicking Yes.


RSLogix 5000
DANGER. Calibration should not be performed on a module currently being used for control.
There also exists a module identity mismatch.
All channels will freeze at their current values, and control may be interrupted.
Continue with Calibration?
Yes
No
Help

7. Set the channels to be calibrated.


Calibration Wizard - Select the Channel(s) to Calibrate
Select the channel(s) to calibrate using the "Calibrate?" checkbox.
Then choose to either Calibrate the Channels in Groups or Calibrate Channels One Channel at a Time
Press "Next" to continue.
Channel
Calibrate?
Calibration Range
Calibration Gain
Calibration Offset (Counts)
Calibration Status
0 0 to 20 mA 0.993774 15 OK
1 0 to 20 mA 0.992981 21 OK
2 0 to 20 mA 0.990356 13 OK
3 0 to 20 mA 0.994446 23 OK
4 0 to 20 mA 0.992615 13 OK
5 0 to 20 mA 0.993469 21 OK
Calibrate Channels in Groups
Calibrate Channels One at a Time
<Back
Next >
Stop
Help

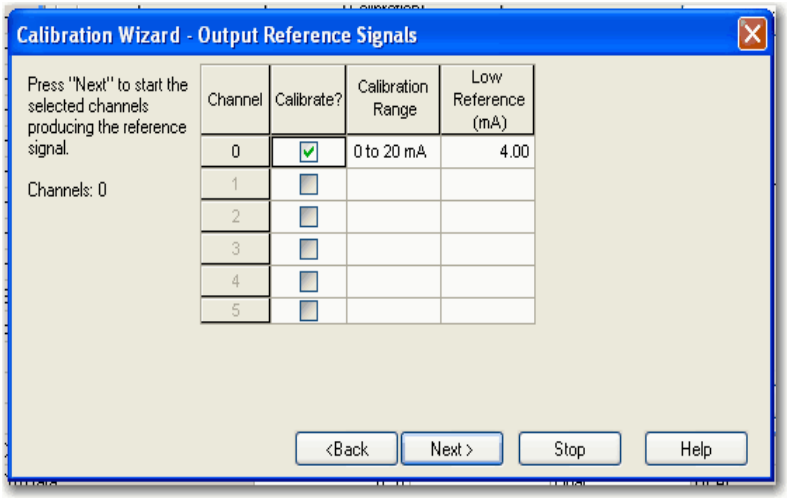
TIP

You can select whether to calibrate channels in groups all at once or each channel at a time.

We recommend you calibrate all channels on your module each time you calibrate. This will help you maintain consistent calibration readings and improve module accuracy.

8. Click Next.

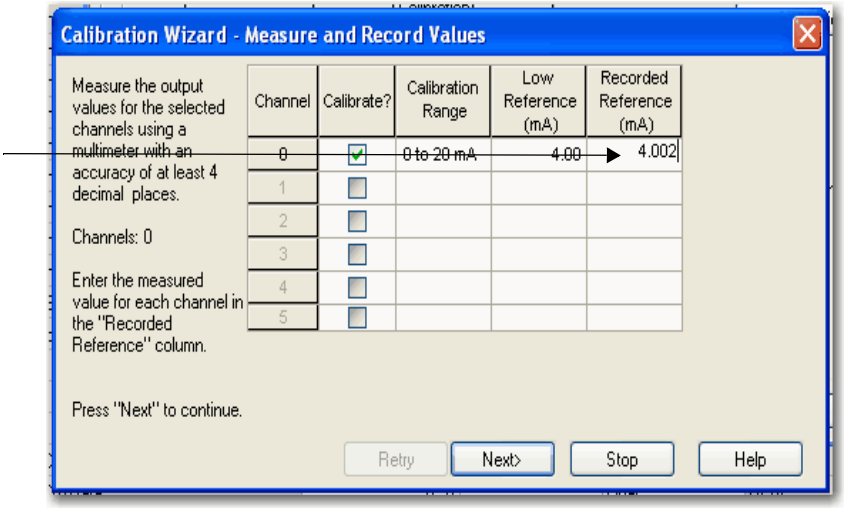
The Output Reference Signals wizard appears to show which channels will be calibrated for a low reference and the range of the calibration. It also shows what reference signal is expected at the input.



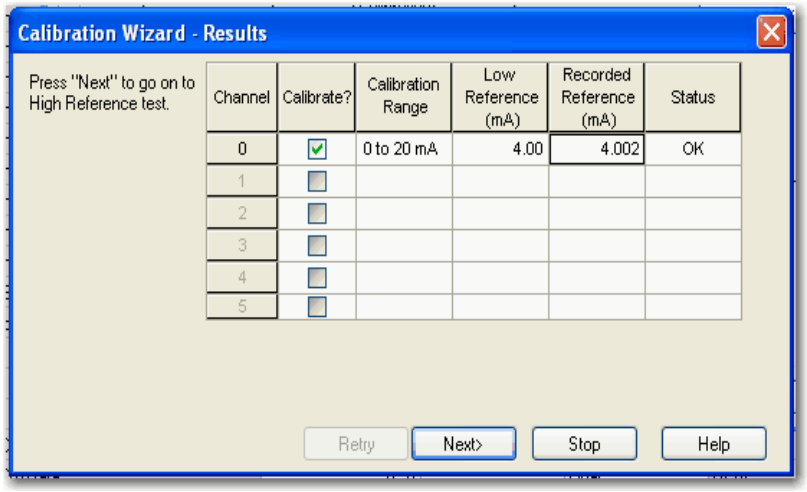
9. Click Next.

TIP Click Back to return to the last window to make any necessary changes. Click Stop to halt the calibration process, if necessary.

10. Record the results of your measurement.



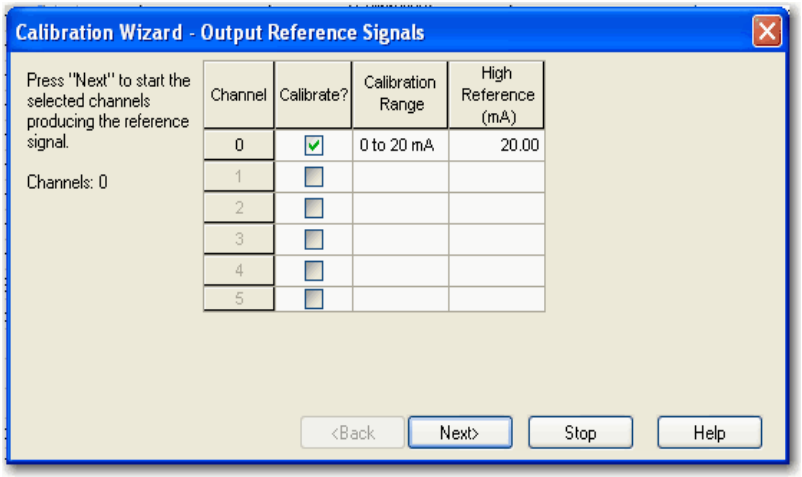
A Results wizard displays the status of each channel after calibrating for a low reference. If channels are OK, continue. If any channel reports an error, retry steps 7…9 until the status is OK.



11. Click Next.

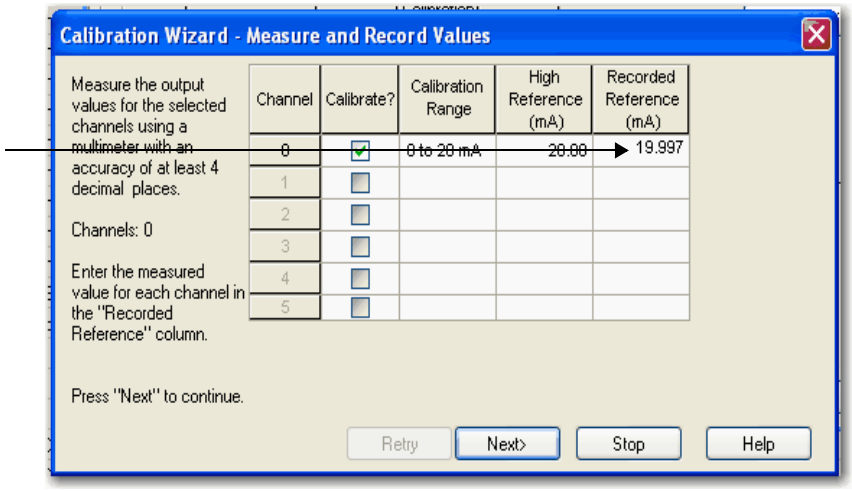
12. Set the channels to be calibrated for a high reference.

The Output Reference Signals wizard appears to show which channels will be calibrated for a high reference and the range of the calibration. It also shows what reference signal is expected at the input.



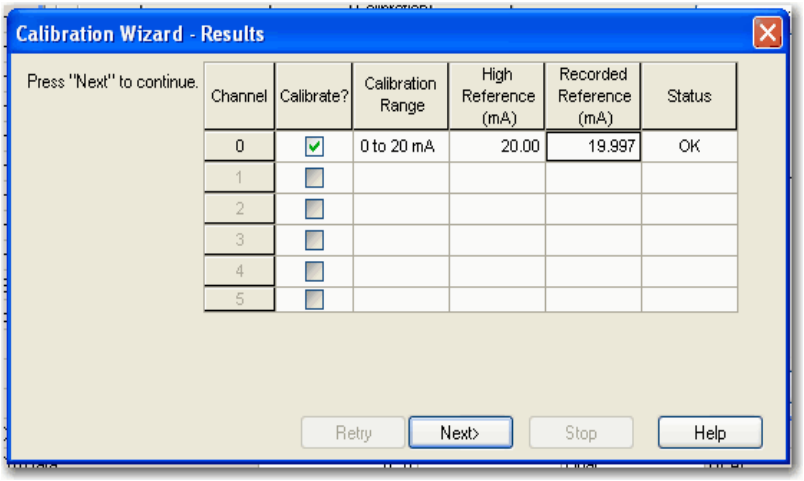
13. Click Next.

14. Record the measurement.

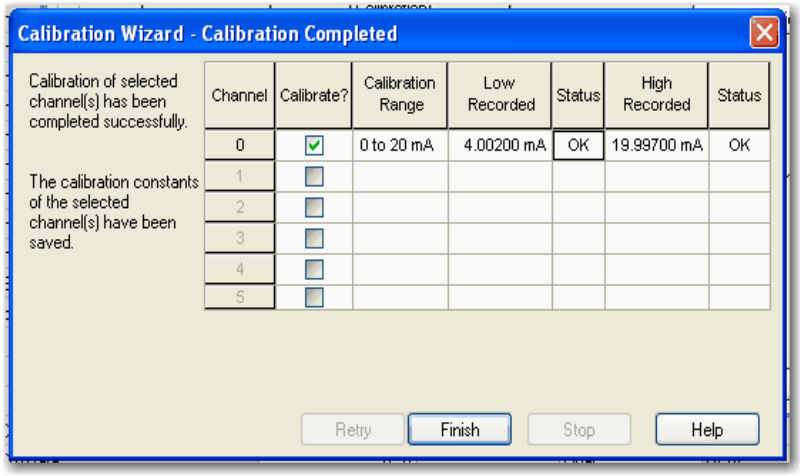


15. Click Next.

A Results wizard displays the status of each channel after calibrating for a high reference. If channels are OK, continue. If any channels report an error, retry steps 12…15 until the status is OK.

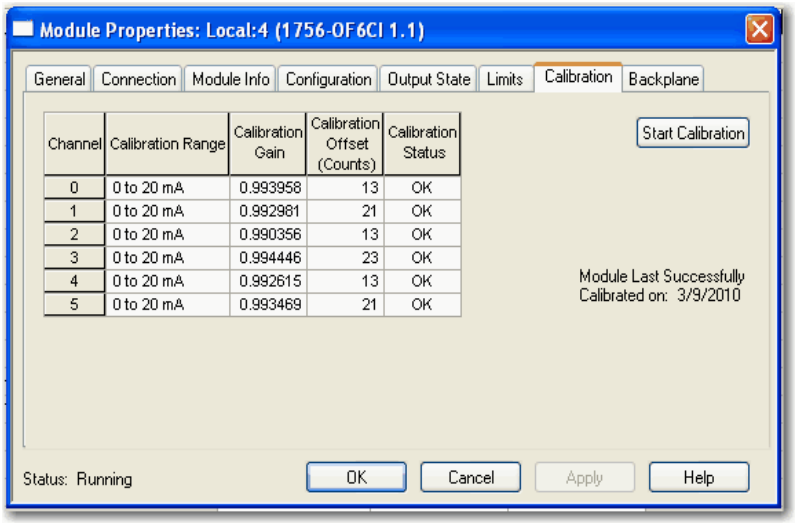


After you have completed both low and high reference calibration, this window shows the status of both.



16. Click Finish.

The Calibration tab on the Module Properties dialog box shows the changes in the Calibration Gain and Calibration Offset. The date of the latest calibration also displays.



17. Click OK.

Voltage Meter Calibrations

RSLogix 5000 software commands the module to output specific levels of voltage. You must measure the actual level and record the results. This measurement allows the module to account for any inaccuracies.

The 1756-OF4, 1756-OF8, and 1756-OF6VI modules use basically the same procedures for being calibrated by a voltage meter.

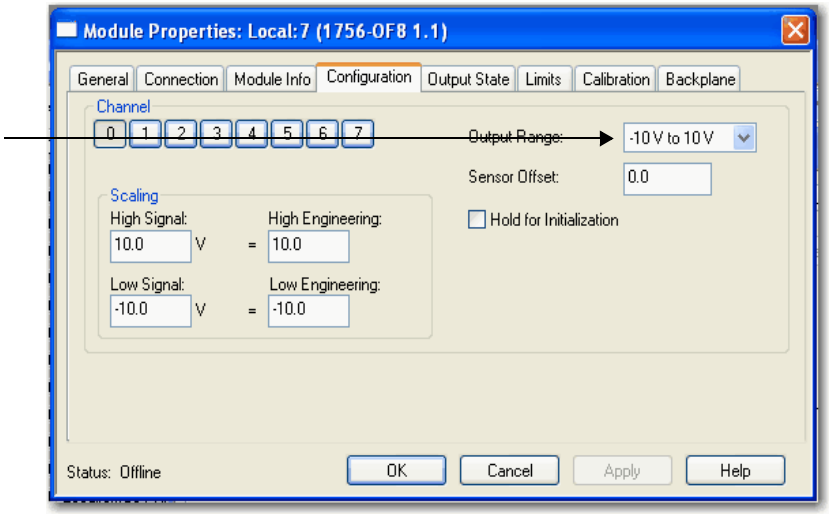
While you are online, you must access the Module Properties dialog box. See page 207 in Chapter 10 for procedures.

Follow these steps to calibrate your module.

1. Connect your voltage meter to the module.

   For the 1756-OF4 and 1756-OF8 modules, do additional steps 2…4. For the 1756-OF6VI module, go to step 5.

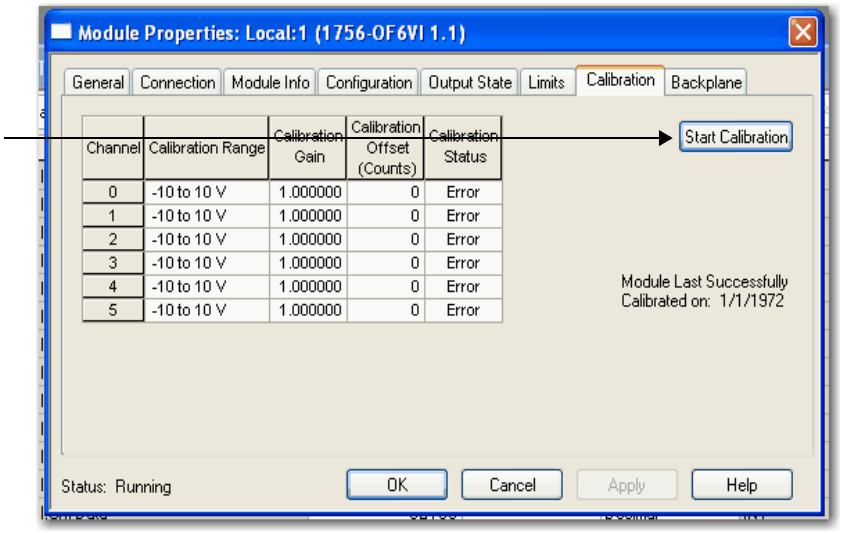
2. Go to the Configuration tab on the Module Properties dialog box.



3. At the Output Range, choose the range from the pull-down menu to calibrate the channels.

4. Click OK.

5. Go to the Calibration tab on the Module Properties dialog box.

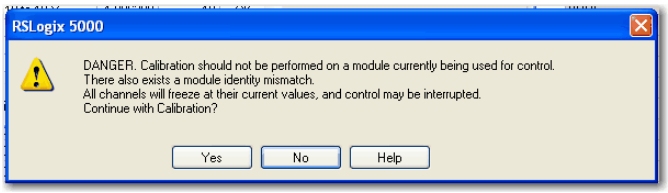


6. Click Start Calibration to access the Calibration Wizard to step through the process.

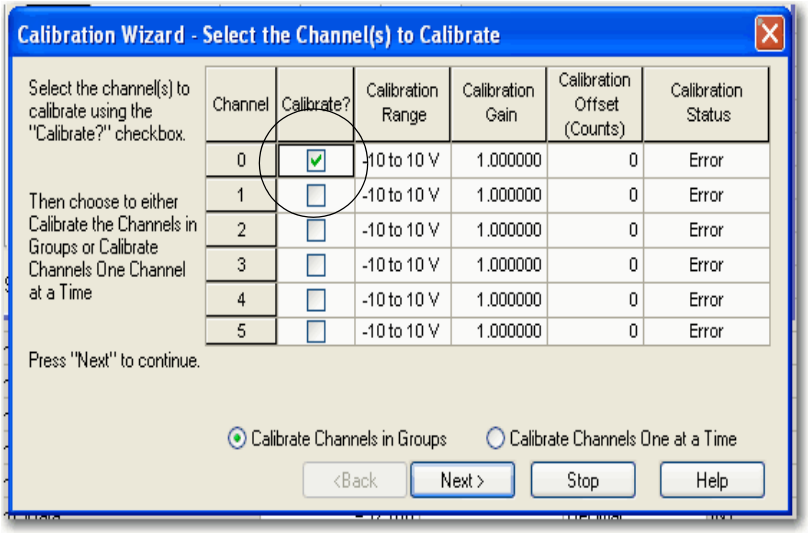
IMPORTANT The 'Error' status for all the channels denotes that the previous calibration process was not successful. We suggest a valid calibration be performed for all channels.

See page 272 for a successful calibration for channel 0.

If your module is not in Program mode, a warning message appears. You must manually change the module to Program mode before clicking Yes.


RSLogix 5000
DANGER. Calibration should not be performed on a module currently being used for control.
There also exists a module identity mismatch.
All channels will freeze at their current values, and control may be interrupted.
Continue with Calibration?
Yes
No
Help

7. Set the channels to be calibrated.


Calibration Wizard - Select the Channel(s) to Calibrate
Select the channel(s) to calibrate using the "Calibrate?" checkbox.
Then choose to either Calibrate the Channels in Groups or Calibrate Channels One Channel at a Time
Press "Next" to continue.
Channel
Calibrate?
Calibration Range
Calibration Gain
Calibration Offset (Counts)
Calibration Status
0 -10 to 10 V 1.000000 0 Error
1 -10 to 10 V 1.000000 0 Error
2 -10 to 10 V 1.000000 0 Error
3 -10 to 10 V 1.000000 0 Error
4 -10 to 10 V 1.000000 0 Error
5 -10 to 10 V 1.000000 0 Error
Calibrate Channels in Groups
Calibrate Channels One at a Time
<Back
Next >
Stop
Help

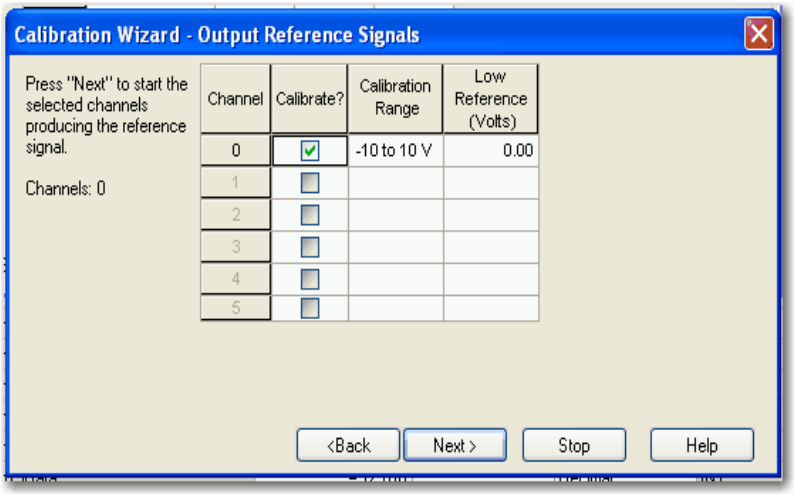
TIP

You can select whether to calibrate channels in groups all at once or each channel at a time.

We recommend you calibrate all channels on your module each time you calibrate. This will help you maintain consistent calibration readings and improve module accuracy.

8. Click Next.

The Output Reference Signals wizard appears to show which channels will be calibrated for a low reference and the range of the calibration. It also shows what reference signal is expected at the input.

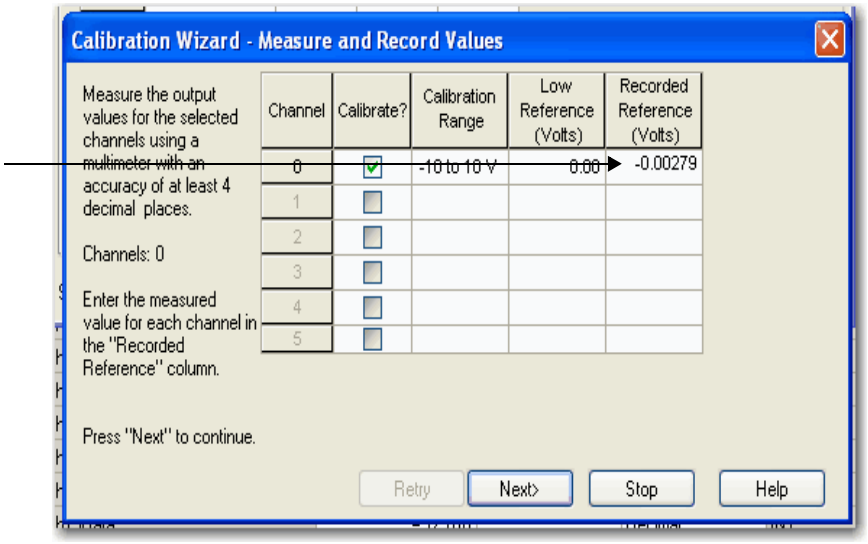


9. Click Next.

TIP

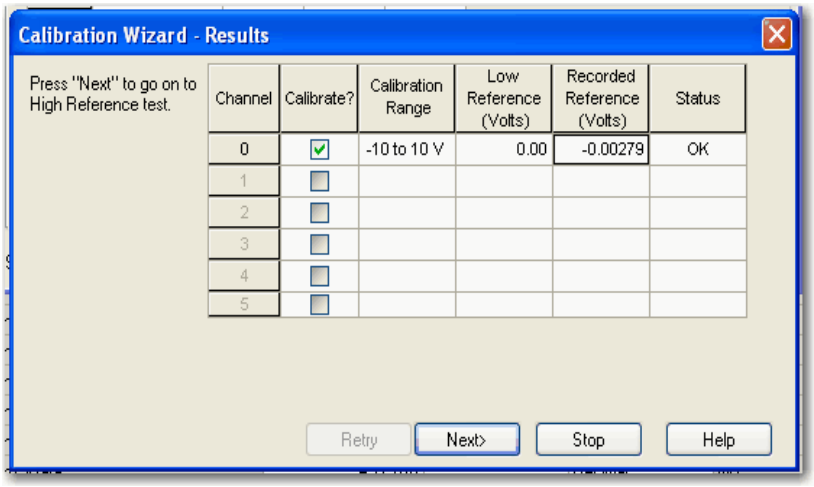
Click Back to return to the last window to make any necessary changes. Click Stop to halt the calibration process, if necessary.

10. Record the measurement.



11. Click Next.

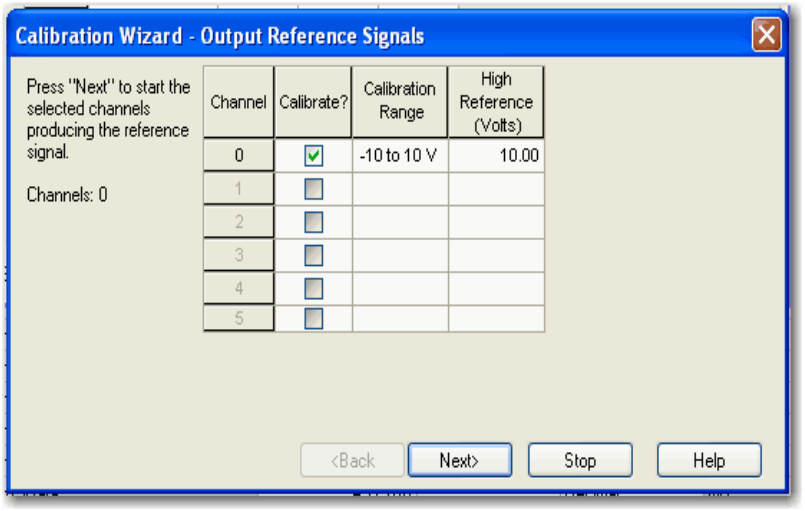
A Results wizard displays the status of each channel after calibrating for a low reference. If channels are OK, continue. If any channel reports an error, retry steps 7…9 until the status is OK.



12. Click Next.

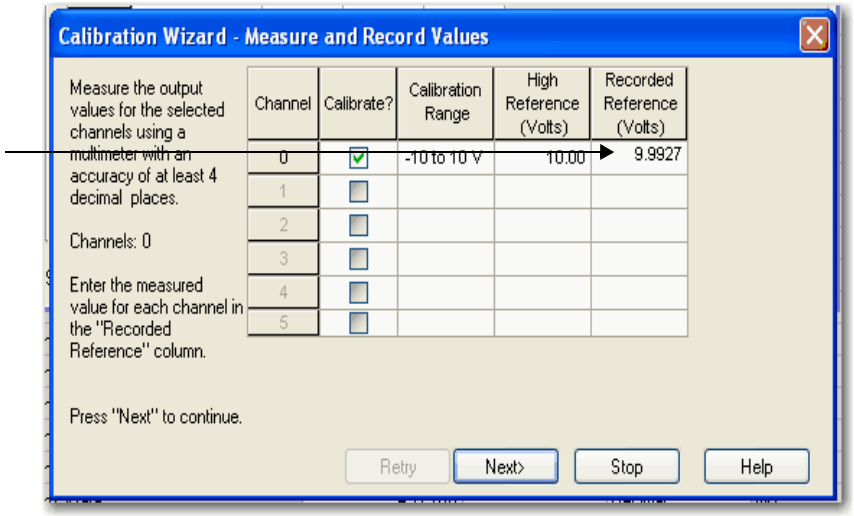
13. Set the channels to be calibrated for a high reference.

The Output Reference Signals wizard appears to show which channels will be calibrated for a high reference and the range of the calibration. It also shows what reference signal is expected at the input.



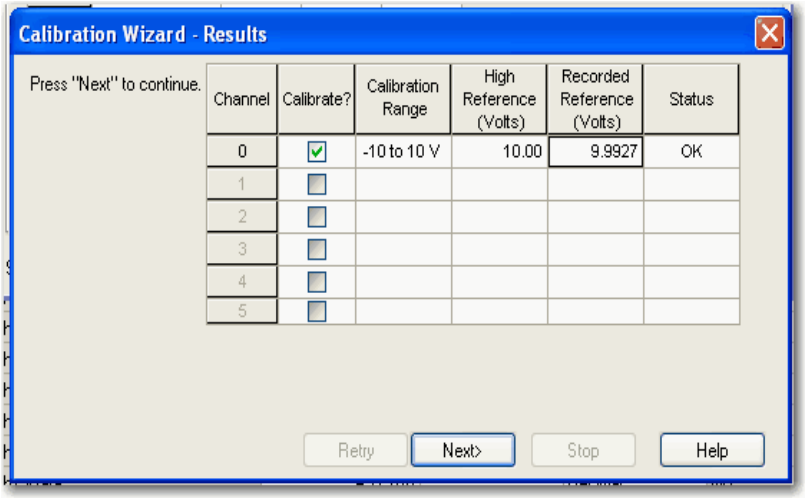
14. Click Next.

15. Record the measurement.

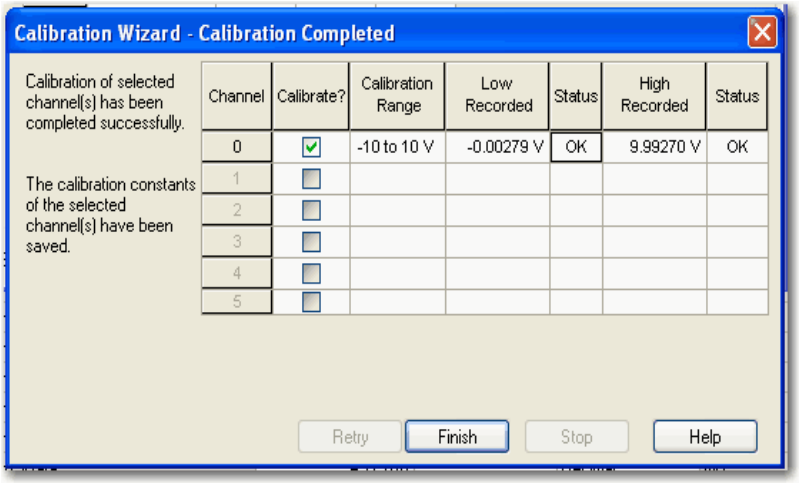


16. Click Next.

A Results wizard displays the status of each channel after calibrating for a high reference. If channels are OK, continue. If any channels report an error, retry steps 13…16 until the status is OK.

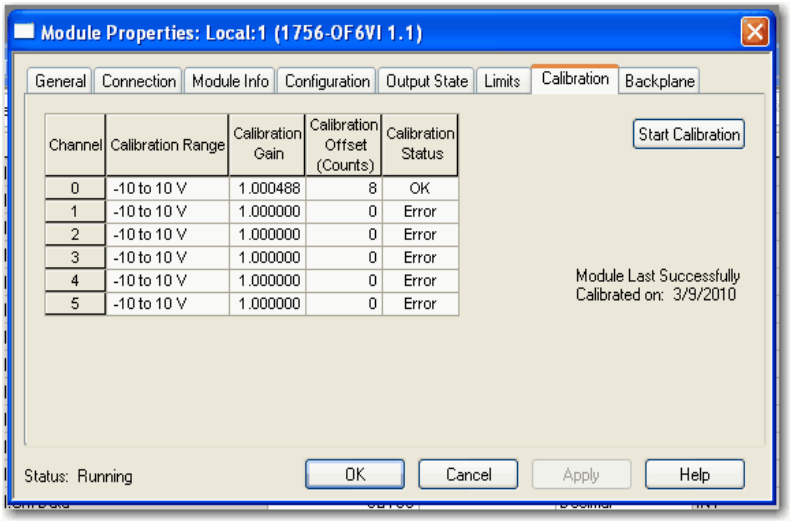


After you have completed both low and high reference calibration, this window shows the status of both.



17. Click Finish.

The Calibration tab on the Module Properties dialog box shows the changes in the Calibration Gain and Calibration Offset. The date of the latest calibration also displays.



18. Click OK.

Troubleshoot Your Module

Introduction

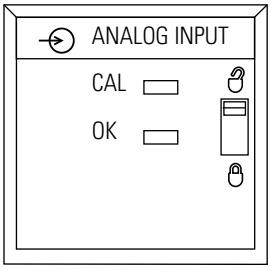
Each ControlLogix analog I/O module has status indicators that display module status. This chapter describes the status indicators, located on the front of a module, and how to use these visual signals to troubleshoot anomalies.

Status indicators show the I/O module state (green), or fault (red).

Topic	Page
Status Indicators for Input Modules	273
Status Indicators for Output Modules	274
Use RSLogix 5000 Software for Troubleshooting	275

Status Indicators for Input Modules

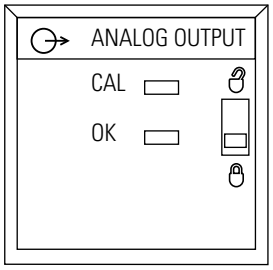
The illustration and table show the status indicators used with analog input modules.



Status Indicator	Display	Description	Action
OK	Steady green light	The inputs are being multicast and in normal operating state.	None
OK	Flashing green light	The module has passed internal diagnostics but is not currently performing connected communication.	None
OK	Flashing red light	Previously established communication has timed out.	Check controller and chassis communication
OK	Steady red light	The module must be replaced.	Replace the module.
CAL	Flashing green light	The module is in Calibration mode.	Finish calibration

Status Indicators for Output Modules

The illustration and table show the status indicators used with analog output modules.



Status Indicator	Display	Description	Action
OK	Steady green light	The outputs are in a normal operating state in Run mode.	None
OK	Flashing green light	Either: • the module has passed internal diagnostics and is not actively controlled • a connection is open and the controller is in Program mode.	None
OK	Flashing red light	Previously established communication has timed out.	Check controller and chassis communication
OK	Steady red light	The module must be replaced.	Replace the module.
CAL	Flashing green light	The module is in Calibration mode.	Finish calibration

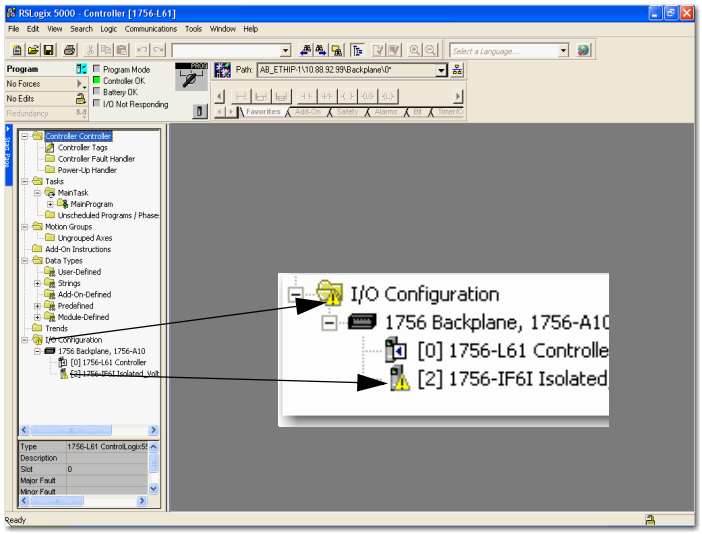
Use RSLogix 5000 Software for Troubleshooting

In addition to the status indicator display on the module, RSLogix 5000 software will alert you to fault conditions. Fault conditions are reported in several ways.

- Warning signal on the main screen next to the module - This occurs when the connection to the module is broken.
- Message in a screen's status line.
- Notification in the Tag Editor - General module faults are also reported in the Tag Editor. Diagnostic faults are reported only in the Tag Editor.
- Status on the Module Info tab.

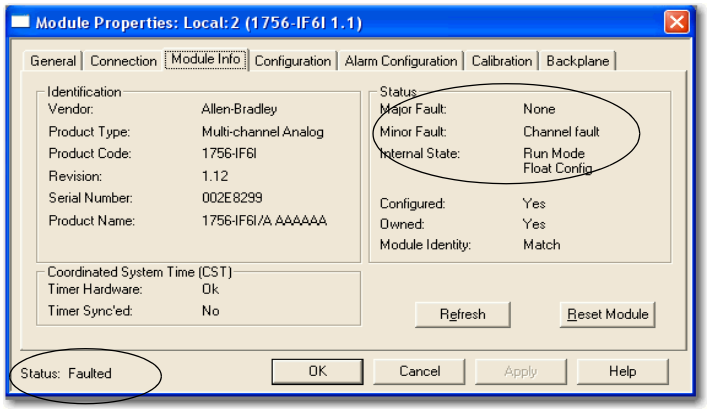
The following windows display fault notification in RSLogix 5000 software.

Warning Signal on Main Screen



A warning icon appears in the I/O Configuration tree when a communication fault occurs.

Fault Message in Status Line



On the Module Info tab, in the Status section, the Major and Minor Faults are listed along with the Internal State of the module.

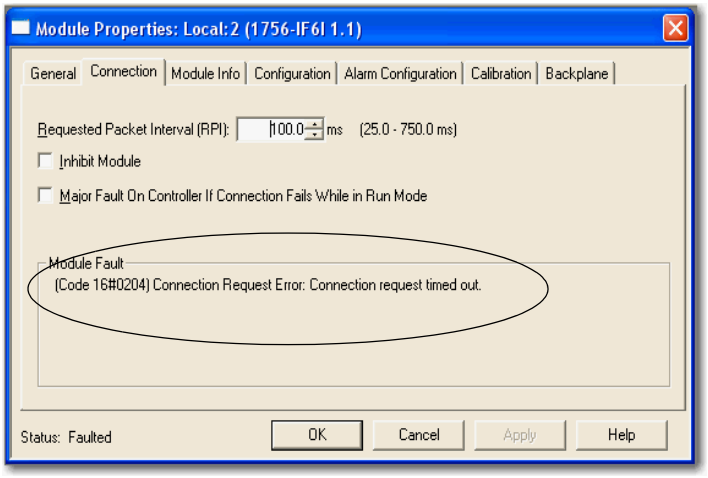
Notification in Tag Editor

Name	Value	Force Mask	Style	Data Type
+ Local:2:C	{...}	{...}		AB:1756_AI6_Flo...
− Local:2:I	{...}	{...}		AB:1756_AI6_Flo...
+ Local:2:I.ChannelFaults	2#1111_111...		Binary	INT
Local:2:I.Ch0Fault	1		Decimal	BOOL
Local:2:I.Ch1Fault	1		Decimal	BOOL

The Value field lists the number 1 in the Fault line.

Fault Type Determination

When you are monitoring a module's configuration properties in RSLogix 5000 software and receive a Communication fault message, the Connection tab lists the type of fault under Module Fault.



Analog I/O Module Specifications

The table lists where in this user manual you can find specifications for the ControlLogix analog I/O modules in this user manual.

IMPORTANT For the latest I/O module specifications, see the 1756 ControlLogix I/O Modules Technical Specifications, publication 1756-TD002.

ControlLogix Analog Modules	Page
1756-IF6CIS	279
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1756-IF16	294
1756-IR6I	299
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1756-IT6I2	308
1756-OF4	312
1756-OF6CI	316
1756-OF6VI	320
1756-OF8	323

1756 Analog I/O Module Features

Module Type	Features
1756 analog input modules	• On-board data alarming • Scaling to engineering units • Real-time channel sampling • Data Format: Integer mode (left justified, 2s complement) IEEE 32-bit floating point • Module conversion method: Sigma-Delta
1756 analog output modules	• Data format: Integer mode (left justified, 2s complement) IEEE 32-bit floating point • Module conversion method: R-Ladder DAC, monotonicity with no missing codes • Module keying: Electronic, software configurable • RTB keying: User-defined mechanical

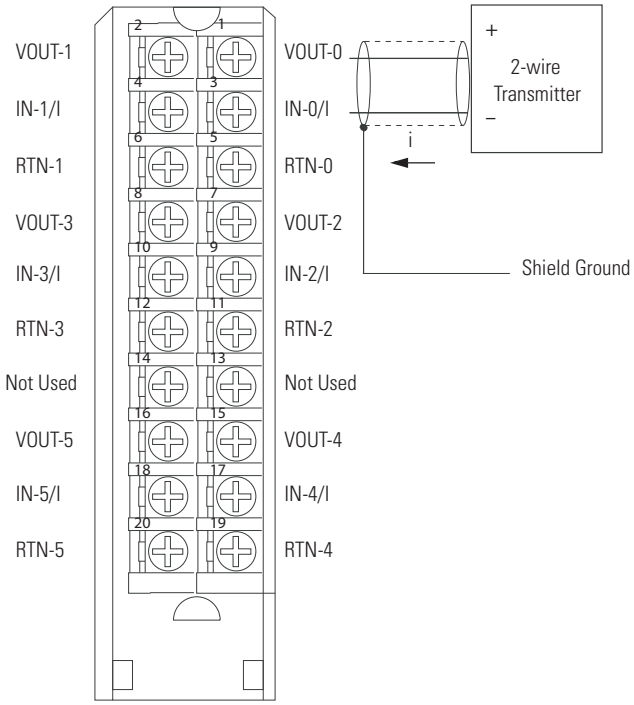
1756 Analog I/O Module Features

Module Type	Features
1756 high-speed analog combination module	• Data format: Integer mode (left justified, 2s complement) IEEE 32-bit floating point • Input conversion method: Successive approximation • Output conversion method: R-Ladder DAC, monotonicity with no missing codes • Module keying: Electronic, software configurable • RTB keying: User-defined mechanical
1756 analog RTD and thermocouple modules	• Data Format: Integer mode (left justified, 2s complement) IEEE 32-bit floating point • Module conversion method: Sigma-Delta • Module keying: Electronic, software configurable • RTB keying: User-defined mechanical
1756 analog modules with HART interface	• Data format: Integer mode (left justified, 2s complement), Floating point IEEE 32 bit • Input conversion method: Successive approximation • Output conversion method: R-Ladder DAC, monotonicity with no missing codes • Module keying: Electronic, software configurable • RTB keying: User-defined mechanical

1756-IF6CIS

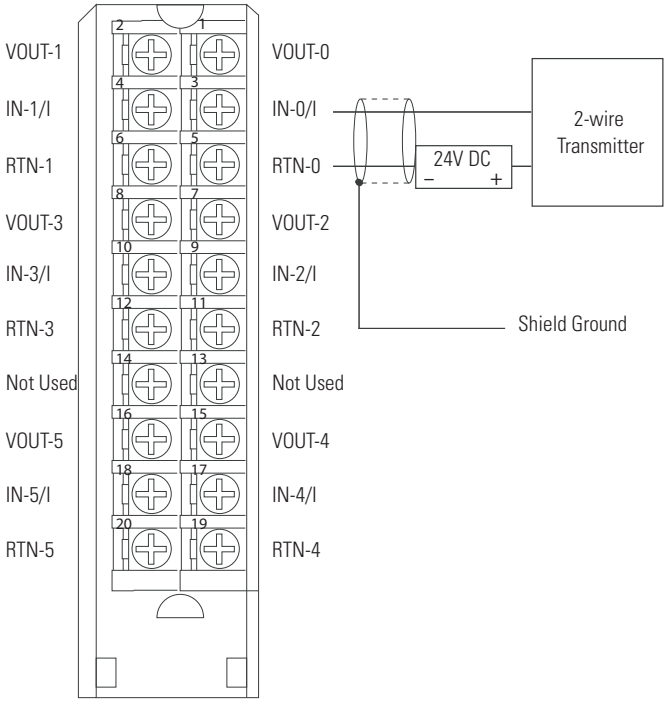
ControlLogix sourcing current loop analog input module

1756-IF6CIS 2-wire Transmitter Connected to the Module and the Module Providing 24V DC Loop Power



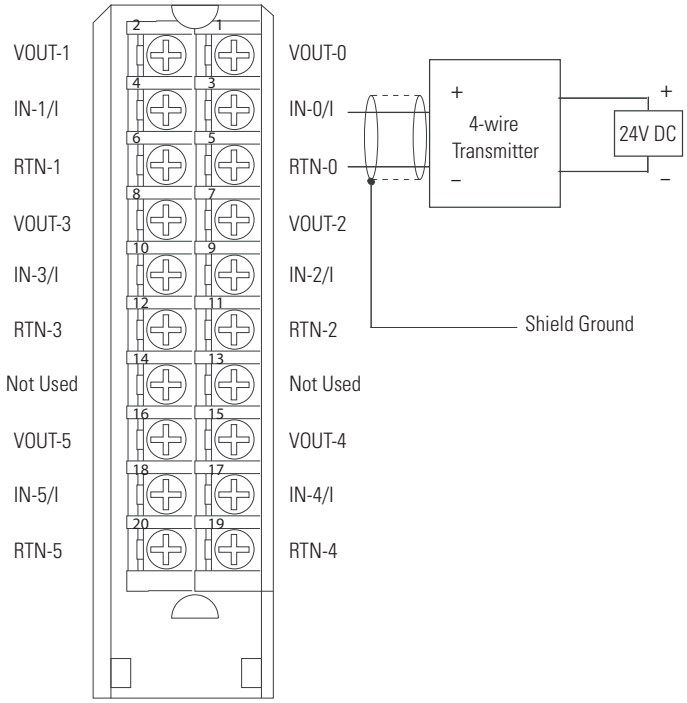
- Do not connect more than two wires to any single terminal.
- Place additional loop devices (such as strip chart recorders) at either A location in the current loop.

1756-IF6CIS 2-wire Transmitter Connected to the Module and an External, User-provided Power Supply Providing 24V DC Loop Power



- If separate power sources are used, do not exceed the specified isolation voltage.
- Do not connect more than two wires to any single terminal.
- Place additional loop devices (such as strip chart recorders) at either A location in the current loop.

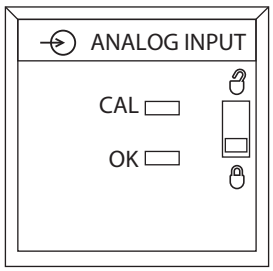
1756-IF6CIS 4-wire Transmitter Connected to the Module and an External, User-provided Power Supply Providing 24V DC Loop Power



- If separate power sources are used, do not exceed the specified isolation voltage.
- Do not connect more than two wires to any single terminal.
- Place additional loop devices (such as strip chart recorders) at either A location in the current loop.

Input Signal to User Count Conversion - 1756-IF6CIS

Range	Low Signal and User Counts	High Signal and User Counts
0…20 mA	0 mA	21.09376 mA
	-32768 counts	32767 counts



Technical Specifications - 1756-IF6CIS

Attribute	1756-IF6CIS
Inputs	6 individually isolated current sourcing
Input range	0…21 mA
Resolution	16 bits 0.34 µA/bit
Current draw @ 5.1V	250 mA
Current draw @ 24V	275 mA
Power dissipation, max	5.1 W @ 60 °C (140 °F)
Thermal dissipation	17.4 BTU/hr
Input impedance	215 Ω approx
Sourcing voltage, min	20V DC
Sourcing voltage, max	30V DC
Sourcing current, max	Current limited to <30 mA

Technical Specifications - 1756-IF6CIS

Attribute	1756-IF6CIS
Open circuit detection time	Zero reading within 5 s
Overvoltage protection, max	30V AC/DC with PTC and sense resistor
Normal mode noise rejection	60 dB @ 60 Hz(1)
Common mode noise rejection	120 dB @ 60 Hz 100 dB @ 50 Hz
Channel bandwidth	3…262 Hz (-3 dB)(1)
Settling time	<80 ms to 5% of full scale(1)
Calibrated accuracy, nom	Better than 0.1% of range @ 25 °C (77 °F)
Calibrated accuracy, max	0.025% of range @ 25 °C (77 °F)
Calibration interval	12 months
Offset drift	200 µA/°C
Gain drift with temperature, nom	17 ppm/°C 0.36 µA/°C
Gain drift with temperature, max	35 ppm/°C max 0.74 µA/°C max
Module error	0.2% of range
Module input scan time, min	25 ms min – floating point 10 ms min – integer
Isolation voltage	250V (continuous), basic insulation type, input channels-to-backplane, and input channel-to-channel Routine tested at 1350V AC for 2 s
Removable terminal block	1756-TBNH 1756-TBSH
Slot width	1
Wire size	0.33… 2.1 mm^2 (22…14 AWG) solid or stranded copper wire rated at 90 °C (194 °F), or greater, 1.2 mm (0.047 in.) insulation max(2)
Wire category	2(3)
North American temperature code	T4A
IEC temperature code	T4
Enclosure type	None (open-style)

(1) Notch filter dependent.

(2) Maximum wire size requires extended housing, catalog number 1756-TBE.

(3) Use this conductor category information for planning conductor routing as described in the system-level installation manual. See the Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1.

Environmental Specifications - 1756-IF6CIS

Attribute	1756-IF6CIS
Temperature, operating IEC 60068-2-1 (Test Ad, Operating Cold), IEC 60068-2-2 (Test Bd, Operating Dry Heat), IEC 60068-2-14 (Test Nb, Operating Thermal Shock)	0…60 °C (32…140 °F)
Temperature, surrounding air	60 °C (140 °F)
Temperature, storage IEC 60068-2-1 (Test Ab, Unpackaged Nonoperating Cold), IEC 60068-2-2 (Test Bb, Unpackaged Nonoperating Dry Heat), IEC 60068-2-14 (Test Na, Unpackaged Nonoperating Thermal Shock)	-40…85 °C (-40…185 °F)
Relative humidity IEC 60068-2-30 (Test Db, Unpackaged Nonoperating Damp Heat)	5…95% noncondensing
Vibration IEC 60068-2-6 (Test Fc, Operating)	2 g @ 10…500 Hz
Shock, operating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	30 g
Shock, nonoperating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	50 g
Emissions	CISPR 11: Group 1, Class A
ESD Immunity IEC 61000-4-2	6 kV contact discharges 8 kV air discharges
Radiated RF Immunity IEC 61000-4-3	10V/m with 1 kHz sine-wave 80% AM from 80... 2000 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 900 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 1890 MHz 3V/m with 1 kHz sine-wave 80% AM from 2000...2700 MHz
EFT/B Immunity IEC 61000-4-4	±2 kV at 5 kHz on shielded signal ports
Surge Transient Immunity IEC 61000-4-5	±2 kV line-earth (CM) on shielded signal ports
Conducted RF Immunity IEC 61000-4-6	10V rms with 1 kHz sine-wave 80% AM from 150 kHz...80 MHz on shielded signal ports

Certifications - 1756-IF6CIS

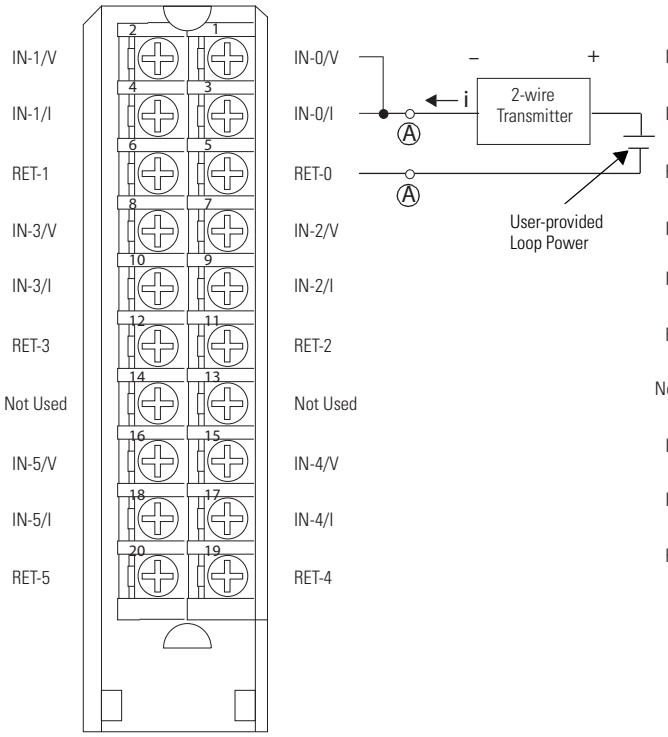
Certification[1]	1756-IF6CIS
UL	UL Listed Industrial Control Equipment, certified for US and Canada. See UL File E65584.
CSA	CSA Certified Process Control Equipment. See CSA File LR54689C. CSA Certified Process Control Equipment for Class I, Division 2 Group A,B,C,D Hazardous Locations. See CSA File LR69960C.
CE	European Union 2004/108/IEC EMC Directive, compliant with: • EN 61326-1; Meas./Control/Lab., Industrial Requirements • EN 61000-6-2; Industrial Immunity • EN 61000-6-4; Industrial Emissions • EN 61131-2; Programmable Controllers (Clause 8, Zone A & B) European Union 2006/95/EC LVD, compliant with: • EN 61131-2; Programmable Controllers (Clause 11)
C-Tick	Australian Radiocommunications Act, compliant with: AS/NZS CISPR 11; Industrial Emissions
Ex	European Union 94/9/EC ATEX Directive, compliant with: • EN 60079-15; Potentially Explosive Atmospheres, Protection "n" • EN 60079-0; General Requirements II 3 G Ex nA IIC T4 X
FM	FM Approved Equipment for use in Class I Division 2 Group A,B,C,D Hazardous Locations
TÜV	TÜV Certified for Functional Safety: Capable of SIL 2

(1) When marked. See the Product Certification link at http://www.ab.com for Declarations of Conformity, Certificates, and other certification details.

1756-IF6I

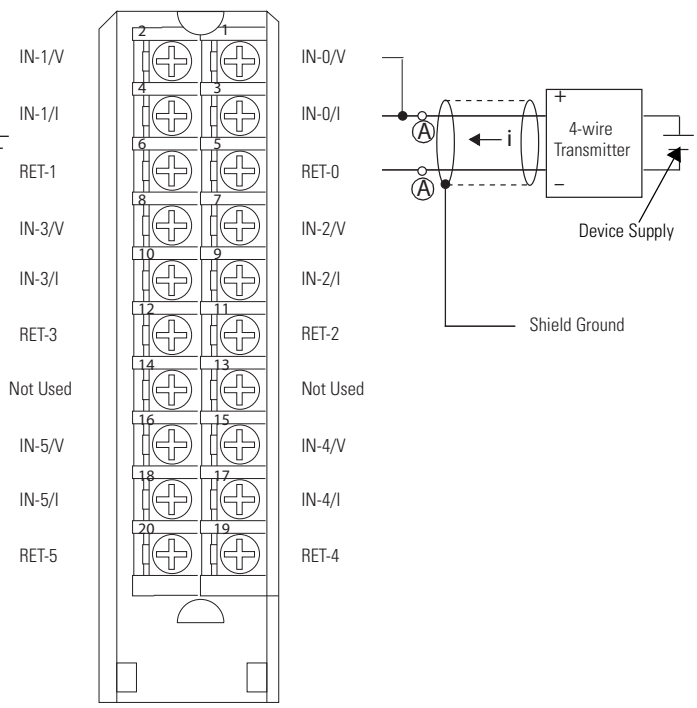
ControlLogix isolated voltage/current analog input module

1756-IF6I Current 2-wire

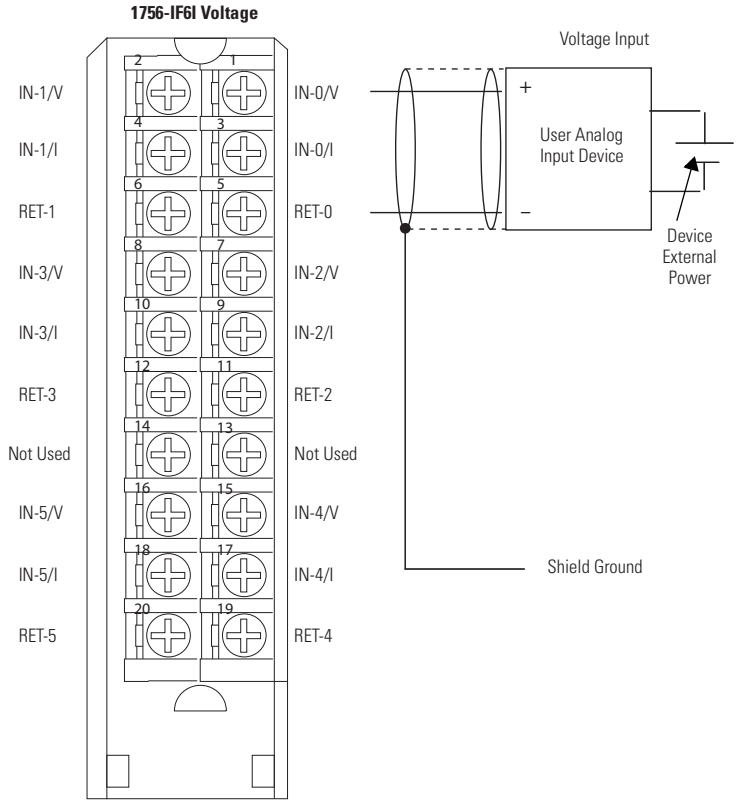


· Place additional loop devices (such as strip chart recorders) at either A location.

1756-IF6I Current 4-wire



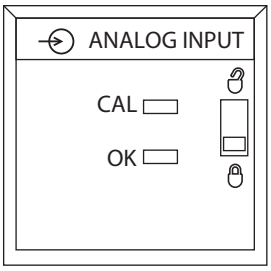
· Place additional loop devices (such as strip chart recorders) at either A location.



· Do not connect more than 2 wires to any single terminal.

Input Signal to User Count Conversion - 1756-IF6I

Range	Low Signal and User Counts	High Signal and User Counts
±10V	-10.54688V -32768 counts	10.54688V 32767 counts
0…10V	0V -32768 counts	10.54688V 32767 counts
0…5V	0V -32768 counts	5.27344V 32767 counts
0…20 mA	0 mA -32768 counts	21.09376V 32767 counts



Technical Specifications - 1756-IF6I

Attribute	1756-IF6I
Inputs	6 individually isolated
Input range	±10.5V 0…10.5V 0…5.25V 0…21 mA
Resolution	16 bits 10.5V: 343 μV/bit 0…10.5V: 171 μV/bit 0…5.25V: 86 μV/bit 0…21 mA: 0.34 μA/bit

Technical Specifications - 1756-IF6I

Attribute	1756-IF6I
Current draw @ 5.1V	250 mA
Current draw @ 24V	100 mA
Power dissipation, max	Voltage: 3.7 W Current: 4.3 W
Thermal dissipation	Voltage: 12.62 BTU/hr Current: 14.32 BTU/hr
Input impedance	Voltage: > 10 MΩ Current: 249 Ω
Open circuit detection time	Positive full scale reading within 5 s
Overvoltage protection, max	Voltage: 120V AC/DC Current: 8V AC/DC (with on-board current resistor)
Normal mode noise rejection	60 dB @ 60 Hz(1)
Common mode noise rejection	120 dB @ 60 Hz 100 dB @ 50 Hz
Channel bandwidth	15 Hz (-3 dB)(1)
Settling time	<80 ms to 5% of full scale(1)
Calibrated accuracy 25 °C	Better than 0.1% of range
Calibration interval	6 months
Offset drift	2 μV/°C
Gain drift with temperature	Voltage: 35 ppm/°C, 80 ppm/°C max Current: 45 ppm/°C, 90 ppm/°C max
Module error	0.54% of range
Module input scan time, min	25 ms min – floating point 10 ms min – integer(1)
Isolation voltage	250V (continuous), basic insulation type, input channels-to-backplane, and input channel-to-channel Routine tested at 1350V AC for 2 s
Removable terminal block	1756-TBNH 1756-TBSH
Slot width	1
Wire size	0.33… 2.1 mm^2 (22…14 AWG) solid or stranded copper wire rated at 90 °C (194 °F), or greater, 1.2 mm (0.047 in.) insulation max(2)
Wire category	2(3)
North American temperature code	T4A
IEC temperature code	T4
Enclosure type	None (open-style)

(1) Notch filter dependent.

(2) Maximum wire size requires extended housing, catalog number 1756-TBE.

(3) Use this conductor category information for planning conductor routing as described in the system-level installation manual. See the Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1.

Environmental Specifications - 1756-IF6I

Attribute	1756-IF6I
Temperature, operating IEC 60068-2-1 (Test Ad, Operating Cold), IEC 60068-2-2 (Test Bd, Operating Dry Heat), IEC 60068-2-14 (Test Nb, Operating Thermal Shock)	0…60 °C (32…140 °F)
Temperature, surrounding air	60 °C (140 °F)
Temperature, storage IEC 60068-2-1 (Test Ab, Unpackaged Nonoperating Cold), IEC 60068-2-2 (Test Bb, Unpackaged Nonoperating Dry Heat), IEC 60068-2-14 (Test Na, Unpackaged Nonoperating Thermal Shock)	-40…85 °C (-40…185 °F)
Relative humidity IEC 60068-2-30 (Test Db, Unpackaged Nonoperating Damp Heat)	5…95% noncondensing
Vibration IEC 60068-2-6 (Test Fc, Operating)	2 g @ 10…500 Hz
Shock, operating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	30 g
Shock, nonoperating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	50 g
Emissions	CISPR 11: Group 1, Class A
ESD Immunity IEC 61000-4-2	6kV contact discharges 8kV air discharges
Radiated RF Immunity IEC 61000-4-3	10V/m with 1 kHz sine-wave 80% AM from 80... 2000 MHz 10V/m with 20 0Hz 50% Pulse 100% AM @ 900 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 1890 MHz 3V/m with 1kHz sine-wave 80% AM from 2000...2700 MHz
EFT/B Immunity IEC 61000-4-4	±2 kV at 5 kHz on shielded signal ports
Surge Transient Immunity IEC 61000-4-5	±2 kV line-earth (CM) on shielded signal ports
Conducted RF Immunity IEC 61000-4-6	10V rms with 1 kHz sine-wave 80% AM from 150 kHz...80 MHz on shielded signal ports

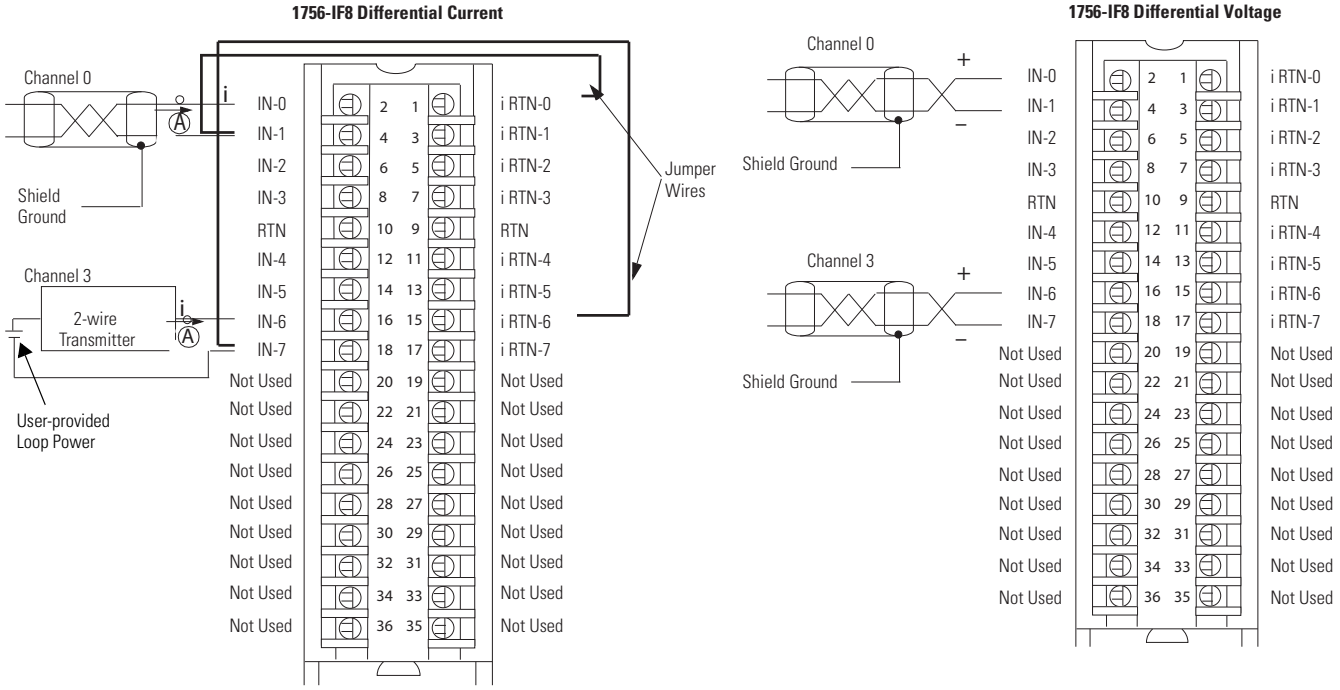
Certifications - 1756-IF6I

Certification[1]	**1756-IF6I**
UL	UL Listed Industrial Control Equipment, certified for US and Canada. See UL File E65584.
CSA	CSA Certified Process Control Equipment. See CSA File LR54689C. CSA Certified Process Control Equipment for Class I, Division 2 Group A,B,C,D Hazardous Locations. See CSA File LR69960C.
CE	European Union 2004/108/IEC EMC Directive, compliant with: • EN 61326-1; Meas./Control/Lab., Industrial Requirements • EN 61000-6-2; Industrial Immunity • EN 61000-6-4; Industrial Emissions • EN 61131-2; Programmable Controllers (Clause 8, Zone A & B) European Union 2006/95/EC LVD, compliant with: • EN 61131-2; Programmable Controllers (Clause 11)
C-Tick	Australian Radiocommunications Act, compliant with: AS/NZS CISPR 11; Industrial Emissions
Ex	European Union 94/9/EC ATEX Directive, compliant with: • EN 60079-15; Potentially Explosive Atmospheres, Protection "n" • EN 60079-0; General Requirements II 3 G Ex nA IIC T4 X
FM	FM Approved Equipment for use in Class I Division 2 Group A,B,C,D Hazardous Locations
TÜV	TÜV Certified for Functional Safety: Capable of SIL 2

(1) When marked. See the Product Certification link at http://www.ab.com for Declarations of Conformity, Certificates, and other certification details.

1756-IF8

ControlLogix voltage/current analog input module



- Use this table when wiring your module in differential current mode.

Table 1.A

This channel	Uses these terminals
Channel 0	IN-0 (+), IN-1 (-), i RTN-0
Channel 1	IN-2 (+), IN-3 (-), i RTN-2
Channel 2	IN-4 (+), IN-5 (-), i RTN-4
Channel 3	IN-6 (+), IN-7 (-), i RTN-6

- All terminals marked RTN are connected internally.
- A 249 Ω current loop resistor is located between IN-*x* and i RTN-*x* terminals.
- If multiple (+) or multiple (-) terminals are tied together, connect that tie point to a RTN terminal to maintain the module's accuracy.
- Place additional loop devices (such as strip chart recorders) at the A location in the current loop.
- Do not connect more than two wires to any single terminal.

IMPORTANT: When operating in two-channel, High-speed mode, only use channels 0 and 2.

- Use this table when wiring your module in differential voltage mode.

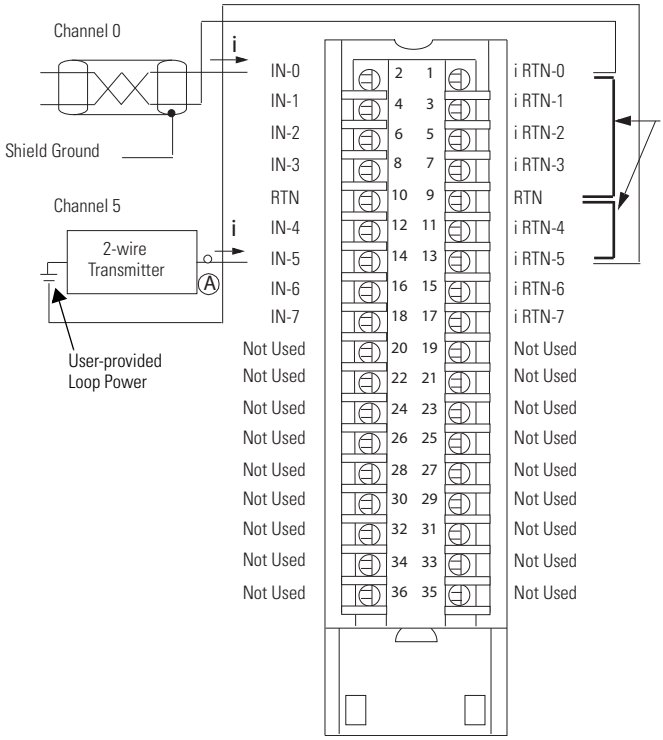
Table 1.B

This channel	Uses these terminals
Channel 0	IN-0 (+), IN-1 (-)
Channel 1	IN-2 (+), IN-3 (-)
Channel 2	IN-4 (+), IN-5 (-)
Channel 3	IN-6 (+), IN-7 (-)

- All terminals marked RTN are connected internally.
- If multiple (+) or multiple (-) terminals are tied together, connect that tie point to a RTN terminal to maintain the module's accuracy.
- Terminals marked RTN or i RTN are not used for differential voltage wiring.
- Do not connect more than two wires to any single terminal.

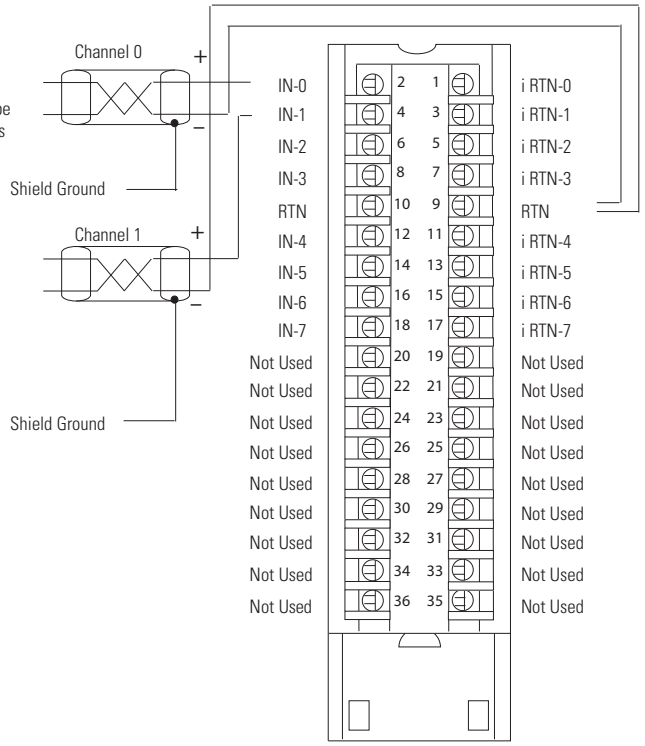
IMPORTANT: When operating in two-channel, High-speed mode, only use channels 0 and 2.

1756-IF8 Single-ended Current

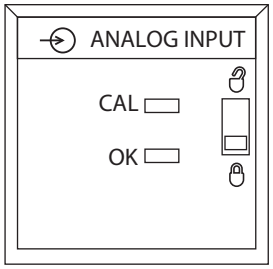


- All terminals marked RTN are connected internally.
- For current applications, all terminals marked iRTN must be wired to terminals marked RTN.
- A 249 Ω current loop resistor is located between IN-*x* and i RTN-*x* terminals.
- Place additional loop devices (such as strip chart recorders) at the A location in the current loop.
- Do not connect more than two wires to any single terminal.

1756-IF8 Single-ended Voltage



- All terminals marked RTN are connected internally.
- Terminals marked i RTN are not used for single-ended voltage wiring.
- Do not connect more than two wires to any single terminal.



Technical Specifications - 1756-IF8

Attribute	1756-IF8
Inputs	8 single-ended 4 differential 2 high-speed differential
Input range	±10.25V 0...10.25V 0...5.125V 0…20.5 mA
Resolution	±10.25V: 320 μV/cnt (15 bits plus sign bipolar) 0…10.25V: 160 μV/cnt (16 bits) 0…5.125V: 80 μV cnt (16 bits) 0…20.5mA: 0.32 μA/cnt (16 bits)
Current draw @ 5.1V	150 mA
Current draw @ 24V	40 mA

Technical Specifications - 1756-IF8

Attribute	1756-IF8
Power dissipation, max	Voltage: 1.73 W Current: 2.33 W
Thermal dissipation	Voltage: 5.88 BTU/hr Current: 7.92 BTU/hr
Input impedance	Voltage: >1 MΩ Current: 249 Ω
Open circuit detection time	Differential voltage: Positive full scale reading within 5 s Single-ended/diff. current: Negative full scale reading within 5 s Single-ended voltage: Even numbered channels go to positive full scale reading within 5 s, odd numbered channels go to negative full scale reading within 5 s
Overvoltage protection, max	Voltage: 30V DC Current: 8V DC
Normal mode noise rejection	>80 dB @ 50/60 Hz(1)
Common mode noise rejection	>100 dB @ 50/60 Hz
Calibrated accuracy 25 °C	Voltage: Better than 0.05% of range Current: Better than 0.15% of range
Calibration interval	12 months
Offset drift	45 µV/°C
Gain drift with temperature	Voltage: 15 ppm/°C Current: 20 ppm/°C
Module error	Voltage: 0.1% of range Current: 0.3% of range
Module input scan time, min	8 pt single-ended (floating point): 16…488 ms 4 pt differential (floating point): 8…244 ms 2 pt differential (floating point): 5…122 m(1)
Isolation voltage	250V (continuous), reinforced insulation type, inputs-to-backplane No isolation between individual inputs Routine tested at 1350V AC for 2 s
Removable terminal block	1756-TBCH 1756-TBS6H
Slot width	1
Wire size	0.33…2.1 mm^2 (22…14 AWG) solid or stranded copper wire rated at 90 °C (194 °F), or greater, 1.2 mm (0.047 in.) insulation max(2)
Wire category	2(3)
North American temperature code	T4A
IEC temperature code	T4
Enclosure type	None (open-style)

(1) Notch filter dependent.

(2) Maximum wire size requires extended housing, catalog number 1756-TBE.

(3) Use this conductor category information for planning conductor routing as described in the system-level installation manual. See the Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1.

Environmental Specifications - 1756-IF8

Attribute	1756-IF8
Temperature, operating IEC 60068-2-1 (Test Ad, Operating Cold), IEC 60068-2-2 (Test Bd, Operating Dry Heat), IEC 60068-2-14 (Test Nb, Operating Thermal Shock)	0…60 °C (32…140 °F)
Temperature, surrounding air	60 °C (140 °F)
Temperature, storage IEC 60068-2-1 (Test Ab, Unpackaged Nonoperating Cold), IEC 60068-2-2 (Test Bb, Unpackaged Nonoperating Dry Heat), IEC 60068-2-14 (Test Na, Unpackaged Nonoperating Thermal Shock)	-40…85 °C (-40…185 °F)
Relative humidity IEC 60068-2-30 (Test Db, Unpackaged Nonoperating Damp Heat)	5…95% noncondensing
Vibration IEC 60068-2-6 (Test Fc, Operating)	2 g @ 10…500 Hz
Shock, operating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	30 g
Shock, nonoperating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	50 g
Emissions	CISPR 11: Group 1, Class A
ESD Immunity IEC 61000-4-2	6 kV contact discharges 8 kV air discharges
Radiated RF Immunity IEC 61000-4-3	10V/m with 1 kHz sine-wave 80% AM from 80... 2000 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 900 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 1890 MHz 3V/m with 1 kHz sine-wave 80% AM from 2000...2700 MHz
EFT/B Immunity IEC 61000-4-4	±2 kV at 5kHz on shielded signal ports
Surge Transient Immunity IEC 61000-4-5	±2 kV line-earth (CM) on shielded signal ports
Conducted RF Immunity IEC 61000-4-6	10V rms with 1 kHz sine-wave 80% AM from 150 kHz...80 MHz on shielded signal ports

Certifications - 1756-IF8

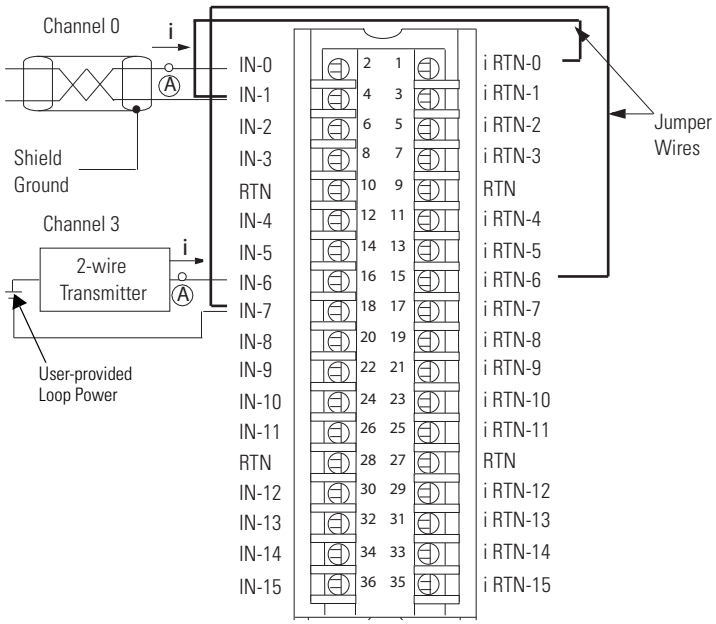
Certification[1]	1756-IF8
UL	UL Listed Industrial Control Equipment, certified for US and Canada. See UL File E65584.
CSA	CSA Certified Process Control Equipment. See CSA File LR54689C. CSA Certified Process Control Equipment for Class I, Division 2 Group A,B,C,D Hazardous Locations. See CSA File LR69960C.
CE	European Union 2004/108/IEC EMC Directive, compliant with: • EN 61326-1; Meas./Control/Lab., Industrial Requirements • EN 61000-6-2; Industrial Immunity • EN 61000-6-4; Industrial Emissions • EN 61131-2; Programmable Controllers (Clause 8, Zone A & B) European Union 2006/95/EC LVD, compliant with: • EN 61131-2; Programmable Controllers (Clause 11)
C-Tick	Australian Radiocommunications Act, compliant with: AS/NZS CISPR 11; Industrial Emissions
Ex	European Union 94/9/EC ATEX Directive, compliant with: • EN 60079-15; Potentially Explosive Atmospheres, Protection "n" • EN 60079-0; General Requirements II 3 G Ex nA IIC T4 X
FM	FM Approved Equipment for use in Class I Division 2 Group A,B,C,D Hazardous Locations
TÜV	TÜV Certified for Functional Safety: Capable of SIL 2

(1) When marked. See the Product Certification link at http://www.ab.com for Declarations of Conformity, Certificates, and other certification details.

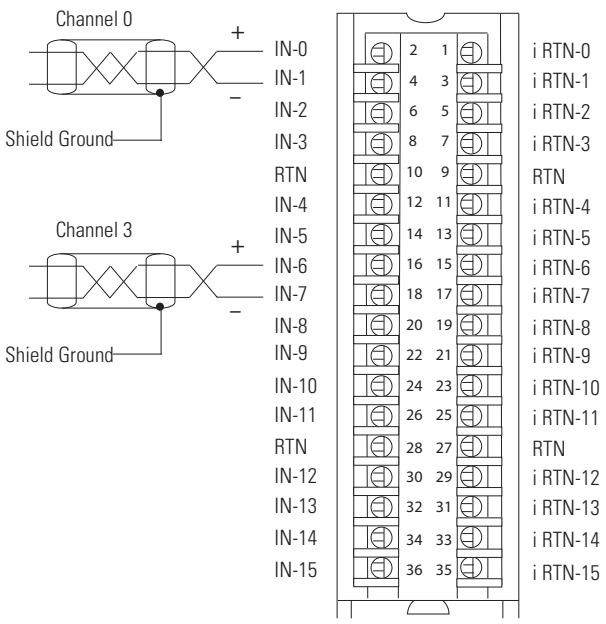
1756-IF16

ControlLogix voltage/current analog input module

1756-IF16 Differential Current



1756-IF16 Differential Voltage



- Use this table when wiring your module in differential current mode.

Table 1.A

This channel	Uses these terminals
Channel 0	IN-0 (+), IN-1 (-), i RTN-0
Channel 1	IN-2 (+), IN-3 (-), i RTN-2
Channel 2	IN-4 (+), IN-5 (-), i RTN-4
Channel 3	IN-6 (+), IN-7 (-), i RTN-6
Channel 4	IN-8 (+), IN-9 (-), i RTN-8
Channel 5	IN-10 (+), IN-11 (-), i RTN-10
Channel 6	IN-12 (+), IN-13 (-), i RTN-12
Channel 7	IN-14 (+), IN-15 (-), i RTN-14

- All terminals marked RTN are connected internally.
- A 249 Ω current loop resistor is located between IN-*x* and i RTN-*x* terminals.
- If multiple (+) or multiple (-) terminals are tied together, connect that tie point to a RTN terminal to maintain the module's accuracy.
- Place additional loop devices (such as strip chart recorders) at the A location in the current loop.
- Do not connect more than two wires to any single terminal.

IMPORTANT: When operating in four-channel, High-speed mode, only use channels 0, 2, 4 and 6.

- Use this table when wiring your module in differential voltage mode.

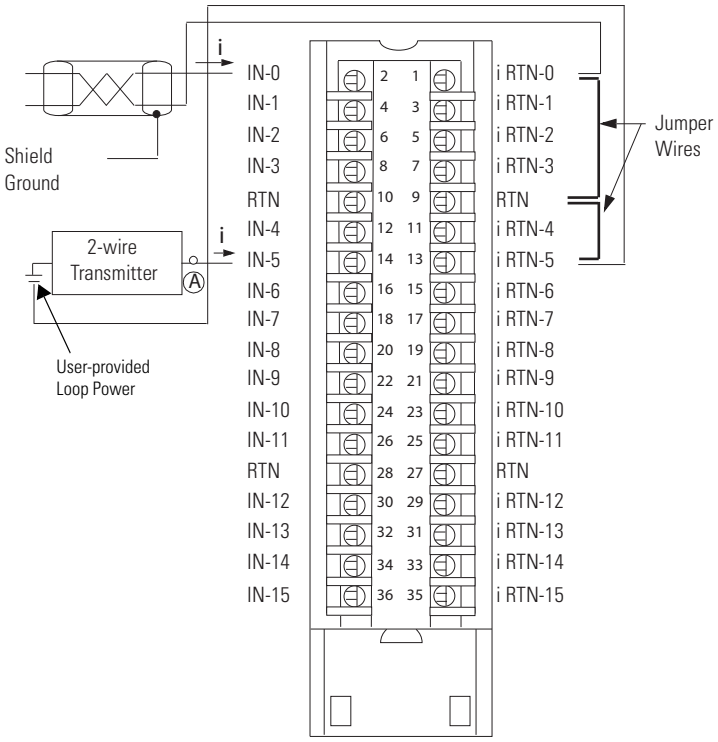
Table 1.B

This channel	Uses these terminals
Channel 0	IN-0 (+), IN-1 (-)
Channel 1	IN-2 (+), IN-3 (-)
Channel 2	IN-4 (+), IN-5 (-)
Channel 3	IN-6 (+), IN-7 (-)
Channel 4	IN-8 (+), IN-9 (-)
Channel 5	IN-10 (+), IN-11 (-)
Channel 6	IN-12 (+), IN-13 (-)
Channel 7	IN-14 (+), IN-15 (-)

- All terminals marked RTN are connected internally.
- If multiple (+) or multiple (-) terminals are tied together, connect that tie point to a RTN terminal to maintain the module's accuracy.
- Terminals marked RTN or i RTN are not used for differential voltage wiring.
- Do not connect more than two wires to any single terminal.

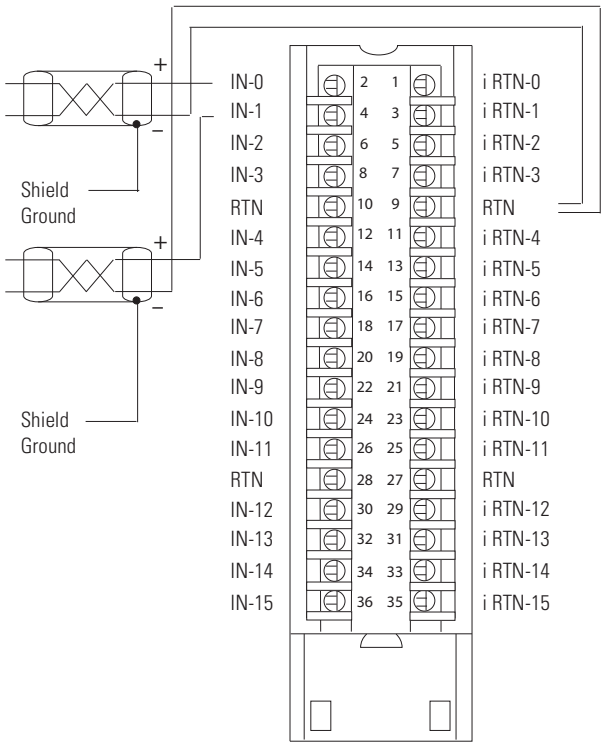
IMPORTANT: When operating in four-channel, High-speed mode, only use channels 0, 2, 4 and 6.

1756-IF16 Single-ended Current

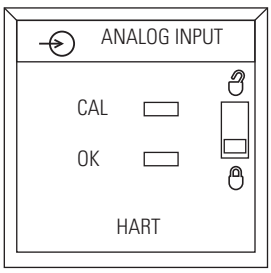


- All terminals marked RTN are connected internally.
- For current applications, all terminals marked i RTN must be wired to terminals marked RTN.
- A 249 Ω current loop resistor is located between IN-*x* and iRTN-*x* terminals.
- Place additional loop devices (such as strip chart recorders) at the A location in the current loop.
- Do not connect more than two wires to any single terminal.

1756-IF16 Single-ended Voltage



- All terminals marked RTN are connected internally.
- Terminals marked i RTN are not used for single-ended voltage wiring.
- Do not connect more than two wires to any single terminal.



Technical Specifications - 1756-IF16

Attribute	1756-IF16
Inputs	16 single ended, 8 differential or 4 differential (high-speed)
Input range	±10.25V 0…10.25V 0…5.125V 0…20.5 mA
Resolution	±10.25V (15 bits + sign bit) 0…10.25V (16 bits) 0…5.1 (16 bits) 0…20.5 mA (16 bits)
Current draw @ 5.1V	150 mA
Current draw @ 24V	65 mA
Power dissipation, max	Voltage:2.3 W Current:3.9 W

Technical Specifications - 1756-IF16

Attribute	1756-IF16
Thermal dissipation	Voltage: 7.84 BTU/hr Current: 13.3 BTU/hr
Input impedance	Voltage: >10 MΩ Current: 249 Ω
Open circuit detection time	Differential voltage - Positive full scale reading within 5 s Single-ended/differential current - Negative full scale reading within 5 s Single-ended voltage - Even numbered channels go to positive full scale reading within 5 s, odd numbered channels go to negative full scale reading within 5 s
Overvoltage protection, max	Voltage: 30V DC Current: 8V DC
Normal mode noise rejection	>80 dB @ 60 Hz(1)
Common mode noise rejection	100 dB @ 50/60 Hz
Channel bandwidth	15 Hz (-3 dB)(1)
Settling time	<80 ms to 5% of full scale(1)
Calibrated accuracy 25 °C (77 °F)	Voltage: Better than 0.05% of range Current: Better than 0.15% of range
Offset drift	45 µV/°C
Gain drift with temperature	Voltage: 15 ppm Current: 20 ppm
Module error	Voltage: 0.1% of range Current: 0.3% of range
Module input scan time, min	16 pt single-ended: 16…488 ms 8 pt differential: 8…244 ms 4 pt differential: 5…122 ms(1)
Isolation voltage	250V (continuous), reinforced insulation type, inputs-to-backplane No isolation between individual inputs Routine tested at 1350V AC for 2 s
Removable terminal block	1756-TBCH 1756-TBS6H
Slot width	1
Wire size	0.33…2.1 mm^2 (22…14 AWG) solid or stranded copper wire rated at 90 °C (194 °F), or greater, 1.2 mm (0.047 in.) insulation max(2)
Wire category	2(3)
North American temperature code	T4A
IEC temperature code	T4
Enclosure type	None (open-style)

(1) Notch filter dependent.

(2) Maximum wire size requires extended housing, catalog number 1756-TBE.

(3) Use this conductor category information for planning conductor routing as described in the system-level installation manual. See the Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1.

Environmental Specifications - 1756-IF16

Attribute	1756-IF16
Temperature, operating IEC 60068-2-1 (Test Ad, Operating Cold), IEC 60068-2-2 (Test Bd, Operating Dry Heat), IEC 60068-2-14 (Test Nb, Operating Thermal Shock)	0…60 °C (32…140 °F)
Temperature, surrounding air	60 °C (140 °F)
Temperature, storage IEC 60068-2-1 (Test Ab, Unpackaged Nonoperating Cold), IEC 60068-2-2 (Test Bb, Unpackaged Nonoperating Dry Heat), IEC 60068-2-14 (Test Na, Unpackaged Nonoperating Thermal Shock)	-40…85 °C (-40…185 °F)
Relative humidity IEC 60068-2-30 (Test Db, Unpackaged Nonoperating Damp Heat)	5…95% noncondensing
Vibration IEC 60068-2-6 (Test Fc, Operating)	2 g @ 10…500 Hz
Shock, operating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	30 g
Shock, nonoperating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	50 g
Emissions	CISPR 11: Group 1, Class A
ESD Immunity IEC 61000-4-2	6 kV contact discharges 8 kV air discharges
Radiated RF Immunity IEC 61000-4-3	10V/m with 1 kHz sine-wave 80% AM from 80... 2000 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 900 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 1890 MHz 3V/m with 1 kHz sine-wave 80% AM from 2000...2700 MHz
EFT/B Immunity IEC 61000-4-4	±2 kV at 5 kHz on shielded signal ports
Surge Transient Immunity IEC 61000-4-5	±2 kV line-earth (CM) on shielded signal ports
Conducted RF Immunity IEC 61000-4-6	10V rms with 1 kHz sine-wave 80% AM from 150 kHz...80 MHz on shielded signal ports

Certifications - 1756-IF16

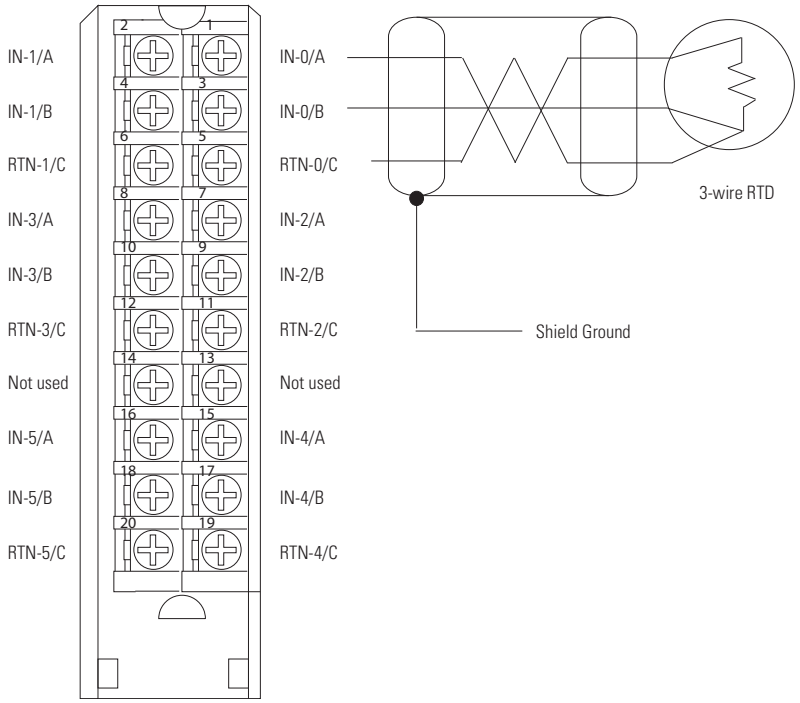
Certification[1]	**1756-IF16**
UL	UL Listed Industrial Control Equipment, certified for US and Canada. See UL File E65584.
CSA	CSA Certified Process Control Equipment. See CSA File LR54689C. CSA Certified Process Control Equipment for Class I, Division 2 Group A,B,C,D Hazardous Locations. See CSA File LR69960C.
CE	European Union 2004/108/IEC EMC Directive, compliant with: • EN 61326-1; Meas./Control/Lab., Industrial Requirements • EN 61000-6-2; Industrial Immunity • EN 61000-6-4; Industrial Emissions • EN 61131-2; Programmable Controllers (Clause 8, Zone A & B) European Union 2006/95/EC LVD, compliant with: • EN 61131-2; Programmable Controllers (Clause 11)
C-Tick	Australian Radiocommunications Act, compliant with: AS/NZS CISPR 11; Industrial Emissions
Ex	European Union 94/9/EC ATEX Directive, compliant with: • EN 60079-15; Potentially Explosive Atmospheres, Protection "n" • EN 60079-0; General Requirements II 3 G Ex nA IIC T4 X
FM	FM Approved Equipment for use in Class I Division 2 Group A,B,C,D Hazardous Locations
TÜV	TÜV Certified for Functional Safety: Capable of SIL 2

(1) When marked. See the Product Certification link at http://www.ab.com for Declarations of Conformity, Certificates, and other certification details.

1756-IR6I

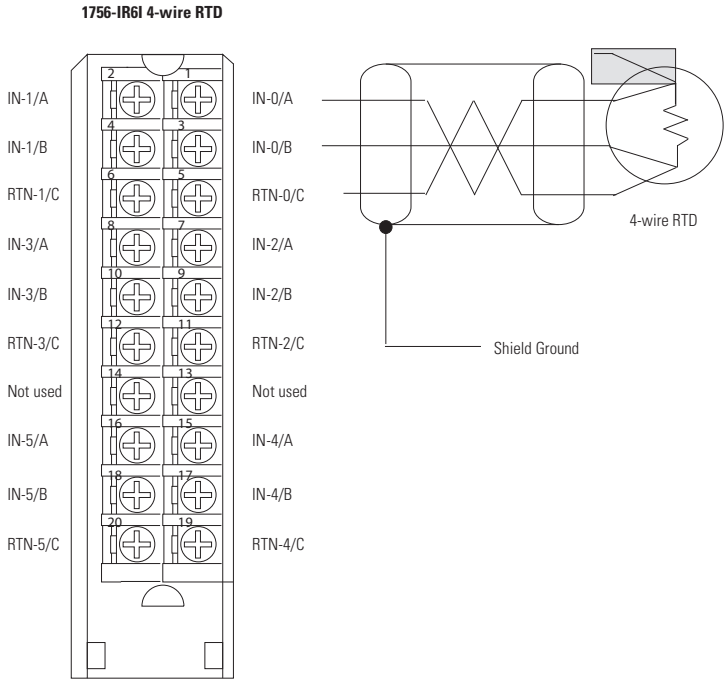
ControlLogix temperature sensing analog input module

1756-IR6I 3-wire RTD



Do not connect more than two wires to any single terminal.

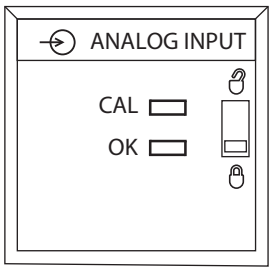
IMPORTANT: For two-wire resistor applications including calibration, make sure IN-*x*/B and RTN-*x*/C are shorted together as shown.



- Do not connect more than two wires to any single terminal.
- Wiring is exactly the same as the three--wire RTD with one wire left open.

Input Signal to User Count Conversion - 1756-IR6I

Range	Low Signal and User Counts	High Signal and User Counts
1...487 Ω	0.859068653 Ω -32768 counts	507.862 Ω 32767 counts
2...1000 Ω	2 Ω -32768 counts	1016.502 Ω 32767 counts
4...2000 Ω	4 Ω -32768 counts	2033.780 Ω 32767 counts
8...4020 Ω	8 Ω -32768 counts	4068.392 Ω 32767 counts



Technical Specifications - 1756-IR6I

Attribute	1756-IR6I
Inputs	6 individually isolated RTD
Input range	1…487 Ω 2…1000 Ω 4…2000 Ω 8…4020 Ω
Resolution	16 bits 1…487 Ω 7.7 mΩ/bit 2…1000 Ω 15 mΩ/bit 4…2000 Ω 30 mΩ/bit 8…4020 Ω 60 mΩ/bit

Technical Specifications - 1756-IR6I

Attribute	1756-IR6I
Sensors supported	100, 200, 500, 1000 Ω Platinum, alpha=385 100, 200, 500, 1000 Ω Platinum, alpha=3916 120 Ω Nickel, alpha=672 100, 120, 200, 500 Ω Nickel, alpha=618 10 Ω Copper
Current draw @ 5.1V	250 mA
Current draw @ 24V	125 mA
Power dissipation, max	4.3 W
Thermal dissipation	14.66 BTU/hr
Open circuit detection time	Negative full scale reading within 5 s with any combination of lost wires, except input terminal A alone. If input terminal A is lost by itself, the module reads a positive full scale reading within 5 s
Overvoltage protection, max	24V AC/DC
Normal mode noise rejection	60 dB at 60 Hz(1)
Common mode noise rejection	120 dB @ 60 Hz 100 dB @ 50 Hz
Channel bandwidth	15 Hz(1)
Settling time	<80 ms to 5% of full scale(1)
Calibrated accuracy @ 25 °C	Better than 0.1% of range
Calibration interval	6 months
Offset drift	10 MΩ/°C
Gain drift with temperature	50 ppm/°C, 90 ppm/°C max
Module error	0.54% of range
Module scan time	25 ms min floating point (ohms) 50 ms min floating point (temperature) 10 ms min integer (ohms)(1)
Isolation voltage	250V (continuous), basic insulation type, input channels-to-backplane, and input channel-to-channel Routine tested at 1350V AC for 2 s
Removable terminal block	1756-TBNH 1756-TBSH
Slot width	1
Wire size	0.33…2.1 mm^2 (22…14 AWG) solid or stranded copper wire rated at 90 °C (194 °F), or greater, 1.2 mm (0.047 in.) insulation max(2)
Wire category	2(3)
North American temperature code	T4A
IEC temperature code	T4
Enclosure type	None (open-style)

(1) Notch filter dependent.

(2) Maximum wire size requires extended housing, catalog number 1756-TBE.

(3) Use this conductor category information for planning conductor routing as described in the system-level installation manual. See the Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1.

Environmental Specifications - 1756-IR6I

Attribute	1756-IR6I
Temperature, operating IEC 60068-2-1 (Test Ad, Operating Cold), IEC 60068-2-2 (Test Bd, Operating Dry Heat), IEC 60068-2-14 (Test Nb, Operating Thermal Shock)	0…60 °C (32…140 °F)
Temperature, surrounding air	60 °C (140 °F)
Temperature, storage IEC 60068-2-1 (Test Ab, Unpackaged Nonoperating Cold), IEC 60068-2-2 (Test Bb, Unpackaged Nonoperating Dry Heat), IEC 60068-2-14 (Test Na, Unpackaged Nonoperating Thermal Shock)	-40…85 °C (-40…185 °F)
Relative humidity IEC 60068-2-30 (Test Db, Unpackaged Nonoperating Damp Heat)	5…95% noncondensing
Vibration IEC 60068-2-6 (Test Fc, Operating)	2 g @ 10…500 Hz
Shock, operating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	30 g
Shock, nonoperating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	50 g
Emissions	CISPR 11: Group 1, Class A
ESD Immunity IEC 61000-4-2	6 kV contact discharges 8 kV air discharges
Radiated RF Immunity IEC 61000-4-3	10V/m with 1 kHz sine-wave 80% AM from 80... 2000 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 900 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 1890 MHz 3V/m with 1 kHz sine-wave 80% AM from 2000...2700 MHz
EFT/B Immunity IEC 61000-4-4	±2 kV at 5 kHz on shielded signal ports
Surge Transient Immunity IEC 61000-4-5	±2 kV line-earth (CM) on shielded signal ports
Conducted RF Immunity IEC 61000-4-6	10V rms with 1 kHz sine-wave 80% AM from 150 kHz...80 MHz on shielded signal ports

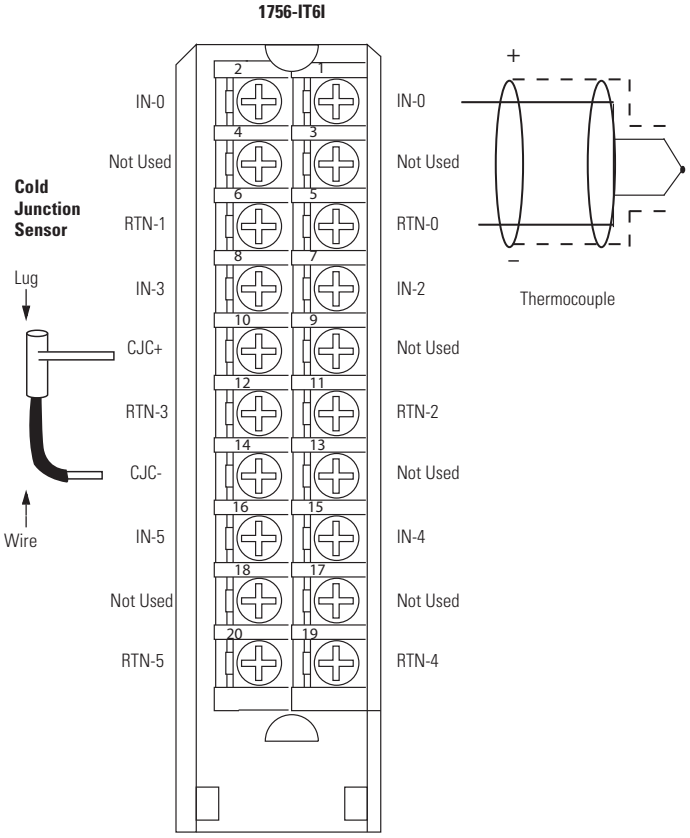
Certifications - 1756-IR6I

Certification[1]	1756-IR6I
UL	UL Listed Industrial Control Equipment, certified for US and Canada. See UL File E65584.
CSA	CSA Certified Process Control Equipment. See CSA File LR54689C. CSA Certified Process Control Equipment for Class I, Division 2 Group A,B,C,D Hazardous Locations. See CSA File LR69960C.
CE	European Union 2004/108/IEC EMC Directive, compliant with: • EN 61326-1; Meas./Control/Lab., Industrial Requirements • EN 61000-6-2; Industrial Immunity • EN 61000-6-4; Industrial Emissions • EN 61131-2; Programmable Controllers (Clause 8, Zone A & B) European Union 2006/95/EC LVD, compliant with: • EN 61131-2; Programmable Controllers (Clause 11)
C-Tick	Australian Radiocommunications Act, compliant with: AS/NZS CISPR 11; Industrial Emissions
Ex	European Union 94/9/EC ATEX Directive, compliant with: • EN 60079-15; Potentially Explosive Atmospheres, Protection "n" • EN 60079-0; General Requirements II 3 G Ex nA IIC T4 X
FM	FM Approved Equipment for use in Class I Division 2 Group A,B,C,D Hazardous Locations
TÜV	TÜV Certified for Functional Safety: Capable of SIL 2

(1) When marked. See the Product Certification link at http://www.ab.com for Declarations of Conformity, Certificates, and other certification details.

1756-IT6I

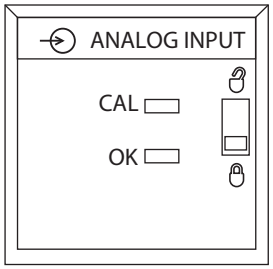
ControlLogix temperature sensing analog input module



- Do not connect more than two wires to any single terminal.
- One CJC is shipped with the module. A replacement can be ordered.

Input Signal to User Count Conversion - 1756-IT6I

Range	Low Signal and User Counts	High Signal and User Counts
-12...30 mV	-15.80323 mV -32768 counts	31.396 mV 32767 counts
-12...78 mV	-15.15836 mV -32768 counts	79.241 mV 32767 counts



Technical Specifications - 1756-IT6I

Attribute	1756-IT6I
Inputs	6 individually isolated thermocouple 1 CJC
Input range	-12…78 mV -12…30 mV
Resolution	16 bits -12...78 mV: 1.4 µV/bit -12...30 mV: 0.7 µV/bit

Technical Specifications - 1756-IT6I

Attribute	1756-IT6I
Thermocouples	B, E, J, K, R, S, T, N, C
Current draw @ 5.1V	250 mA
Current draw @ 24V	125 mA
Power dissipation, max	4.3 W
Thermal dissipation	14.66 BTU/hr
Input impedance	>10 MΩ
Open circuit detection time	Positive full scale reading within 2 s
Overvoltage protection, max	120V AC/DC
Normal mode noise rejection	60 dB at 60 Hz(1)
Common mode noise rejection	120 dB @ 60 Hz 100 dB @ 50 Hz
Channel bandwidth	15 Hz (-3 dB)(1)
Settling time	<80 ms to 5% of full scale(1)
Calibrated accuracy @ 25 °C	Better than 0.1% of range
Calibration interval	6 months
Local CJC sensor accuracy	±0.3…3.2 °C, depending on channel
Remote CJC sensor accuracy	±0.3 °C
Offset drift	0.5 µV/°C
Gain drift with temperature	65 ppm/°C, 80 ppm/°C max
Module error	0.5% of range
Module scan time	25 ms min floating point (millivolt) 50 ms min floating point (temperature) 10 ms min integer (millivolt)(1)
Isolation voltage	250V (continuous), basic insulation type, input channels to backplane, and input channel to channel Routine tested at 1350V AC for 2 s
Removable terminal block	1756-TBNH 1756-TBSH
Slot width	1
Wire size	0.33… 2.1 mm^2 (22…14 AWG) solid or stranded copper wire rated at 90 °C (194 °F), or greater, 1.2 mm (0.047 in.) insulation max(2)
Wire category	2(3)
North American temperature code	T4A
IEC temperature code	T4
Enclosure type	None (open-style)

(1) Notch filter dependent.

(2) Maximum wire size requires extended housing, catalog number 1756-TBE.

(3) Use this conductor category information for planning conductor routing as described in the system-level installation manual. See the Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1.

Environmental Specifications - 1756-IT6I

Attribute	1756-IT6I
Temperature, operating IEC 60068-2-1 (Test Ad, Operating Cold), IEC 60068-2-2 (Test Bd, Operating Dry Heat), IEC 60068-2-14 (Test Nb, Operating Thermal Shock)	0…60 °C (32…140 °F)
Temperature, surrounding air	60 °C (140 °F)
Temperature, storage IEC 60068-2-1 (Test Ab, Unpackaged Nonoperating Cold), IEC 60068-2-2 (Test Bb, Unpackaged Nonoperating Dry Heat), IEC 60068-2-14 (Test Na, Unpackaged Nonoperating Thermal Shock)	-40…85 °C (-40…185 °F)
Relative humidity IEC 60068-2-30 (Test Db, Unpackaged Nonoperating Damp Heat)	5…95% noncondensing
Vibration IEC 60068-2-6 (Test Fc, Operating)	2 g @ 10…500 Hz
Shock, operating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	30 g
Shock, nonoperating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	50 g
Emissions	CISPR 11: Group 1, Class A
ESD Immunity IEC 61000-4-2	6 kV contact discharges 8 kV air discharges
Radiated RF Immunity IEC 61000-4-3	10V/m with 1 kHz sine-wave 80% AM from 80... 2000 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 900 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 1890 MHz 3V/m with 1 kHz sine-wave 80% AM from 2000...2700 MHz
EFT/B Immunity IEC 61000-4-4	±2 kV at 5 kHz on shielded signal ports
Surge Transient Immunity IEC 61000-4-5	±2 kV line-earth (CM) on shielded signal ports
Conducted RF Immunity IEC 61000-4-6	10Vrms with 1 kHz sine-wave 80% AM from 150 kHz...80 MHz on shielded signal ports

Certifications - 1756-IT6I

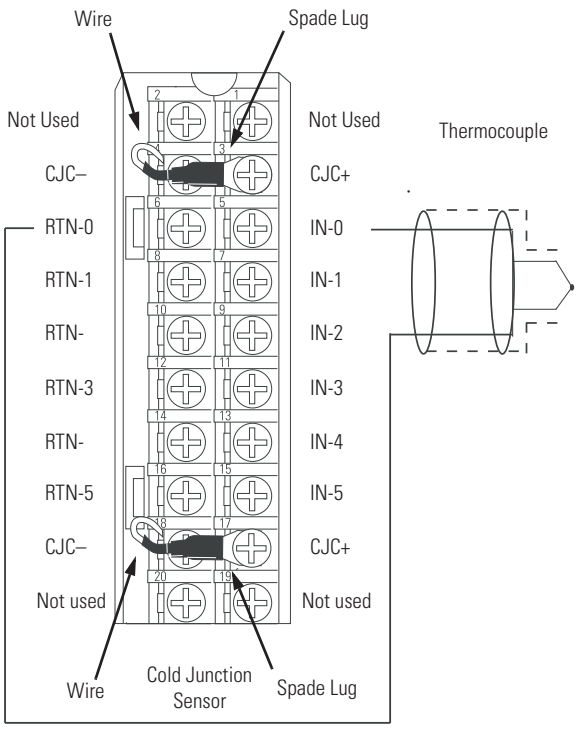
Certification[1]	1756-IT6I
UL	UL Listed Industrial Control Equipment, certified for US and Canada. See UL File E65584.
CSA	CSA Certified Process Control Equipment. See CSA File LR54689C. CSA Certified Process Control Equipment for Class I, Division 2 Group A,B,C,D Hazardous Locations. See CSA File LR69960C.
CE	European Union 2004/108/IEC EMC Directive, compliant with: • EN 61326-1; Meas./Control/Lab., Industrial Requirements • EN 61000-6-2; Industrial Immunity • EN 61000-6-4; Industrial Emissions • EN 61131-2; Programmable Controllers (Clause 8, Zone A & B) European Union 2006/95/EC LVD, compliant with: • EN 61131-2; Programmable Controllers (Clause 11)
C-Tick	Australian Radiocommunications Act, compliant with: AS/NZS CISPR 11; Industrial Emissions
Ex	European Union 94/9/EC ATEX Directive, compliant with: • EN 60079-15; Potentially Explosive Atmospheres, Protection "n" • EN 60079-0; General Requirements II 3 G Ex nA IIC T4 X
FM	FM Approved Equipment for use in Class I Division 2 Group A,B,C,D Hazardous Locations
TÜV	TÜV Certified for Functional Safety: Capable of SIL 2

(1) When marked. See the Product Certification link at http://www.ab.com for Declarations of Conformity, Certificates, and other certification details.

1756-IT6I2

ControlLogix enhanced thermocouple analog input module

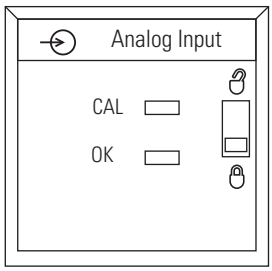
1756-IT6I2 Cold Junction Sensor



- Do not connect more than two wires to any single terminal.
- Two CJCs are shipped with the module. Replacements can be ordered.

Input Signal to User Count Conversion - 1756-IT6I2

Range	Low Signal and User Counts	High Signal and User Counts
-12...30 mV	-15.80323 mV -32768 counts	31.396 mV 32767 counts
-12...78 mV	-15.15836 mV -32768 counts	79.241 mV 32767 counts



Technical Specifications - 1756-IT6I2

Attribute	1756-IT6I2
Inputs	6 individually isolated thermocouple 2 CJC
Input range	-12…78 mV (1.4 µV per bit) -12…30 mV (0.7 µV per bit – high resolution range)
Resolution	16 bits -12...78 mV: 1.4 µV/bit -12...30 mV: 0.7 µV/bit
Thermocouples	B, E, J, K, R, S, T, N, C, D, L (TXK/XK)

Technical Specifications - 1756-IT6I2

Attribute	1756-IT6I2
Current draw @ 5.1V	200 mA
Current draw @ 24V	150 mA
Power dissipation, max	4.6 W
Thermal dissipation	15.7 BTU/hr
Open circuit detection time	Positive full scale reading within 2 s
Overvoltage protection, max	120V AC/DC
Normal mode noise rejection	60 dB at 60 Hz(1)
Common mode noise rejection	160 dB min, tested @ 600V AC/60 Hz applied with 100 Ω differential resistance
Channel bandwidth	15 Hz(1)
Settling time	<80 ms to 5% of full scale(1)
Calibrated accuracy @ 25 °C	Better than 0.1% of range
Calibration interval	12 months
Local CJC sensor accuracy	±0.3 °C
Remote CJC sensor accuracy	±0.3 °C
Offset drift	0.5 µV/°C
Gain drift with temperature	15 ppm/°C, 25 ppm/°C max 1.4 µV/°C, 2.3 µV/°C max, -12…78 mV 0.6 µV/°C, 1.1 µV/°C max, -12…30 mV
Module error	0.15% of range
Module scan time	25 ms min floating point (millivolt) 50 ms min floating point (temperature) 10 ms min integer (millivolt)(1)
Isolation voltage	250V (continuous), basic insulation type, input channels-to-backplane, and input channel-to-channel Routine tested at 1350V AC for 2 s
Removable terminal block	1756-TBNH 1756-TBSH
Slot width	1
Wire size	0.33…2.1 mm^2 (22…14 AWG) solid or stranded copper wire rated at 90 °C (194 °F), or greater, 1.2 mm (0.047 in.) insulation max(2)
Wire category	2(3)
North American temperature code	T4A
IEC temperature code	T4
Enclosure type	None (open-style)

(1) Notch filter dependent.

(2) Maximum wire size requires extended housing, catalog number 1756-TBE.

(3) Use this conductor category information for planning conductor routing as described in the system-level installation manual. See the Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1.

Environmental Specifications - 1756-IT6I2

Attribute	1756-IT6I2
Temperature, operating IEC 60068-2-1 (Test Ad, Operating Cold), IEC 60068-2-2 (Test Bd, Operating Dry Heat), IEC 60068-2-14 (Test Nb, Operating Thermal Shock)	0…60 °C (32…140 °F)
Temperature, surrounding air	60 °C (140 °F)
Temperature, storage IEC 60068-2-1 (Test Ab, Unpackaged Nonoperating Cold), IEC 60068-2-2 (Test Bb, Unpackaged Nonoperating Dry Heat), IEC 60068-2-14 (Test Na, Unpackaged Nonoperating Thermal Shock)	-40…85 °C (-40…185 °F)
Relative humidity IEC 60068-2-30 (Test Db, Unpackaged Nonoperating Damp Heat)	5…95% noncondensing
Vibration IEC 60068-2-6 (Test Fc, Operating)	2 g @ 10…500 Hz
Shock, operating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	30 g
Shock, nonoperating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	50 g
Emissions	CISPR 11: Group 1, Class A
ESD Immunity IEC 61000-4-2	6 kV contact discharges 8 kV air discharges
Radiated RF Immunity IEC 61000-4-3	10V/m with 1 kHz sine-wave 80% AM from 80... 2000 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 900 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 1890 MHz 3V/m with 1 kHz sine-wave 80% AM from 2000...2700 MHz
EFT/B Immunity IEC 61000-4-4	±2 kV at 5 kHz on shielded signal ports
Surge Transient Immunity IEC 61000-4-5	±2 kV line-earth (CM) on shielded signal ports
Conducted RF Immunity IEC 61000-4-6	10V rms with 1 kHz sine-wave 80% AM from 150 kHz...80 MHz on shielded signal ports

Certifications - 1756-IT6I2

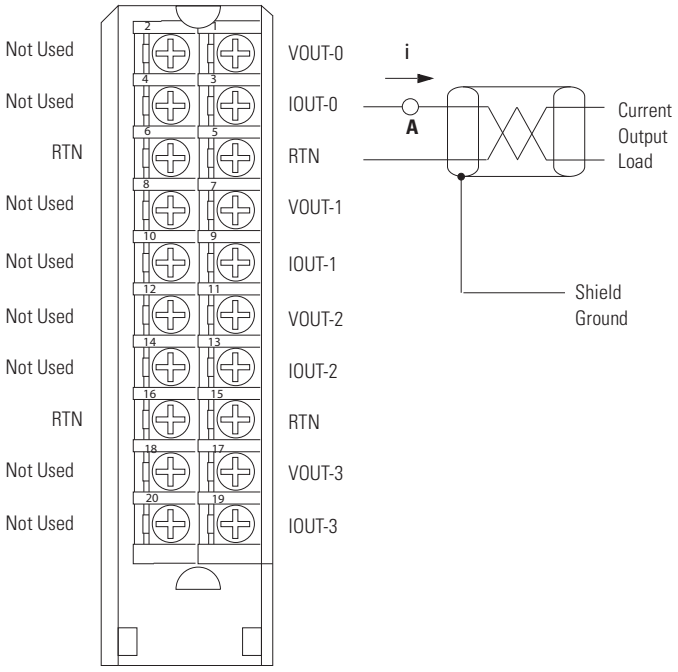
Certification[1]	1756-IT6I2
UL	UL Listed Industrial Control Equipment, certified for US and Canada. See UL File E65584.
CSA	CSA Certified Process Control Equipment. See CSA File LR54689C. CSA Certified Process Control Equipment for Class I, Division 2 Group A,B,C,D Hazardous Locations. See CSA File LR69960C.
CE	European Union 2004/108/IEC EMC Directive, compliant with: • EN 61326-1; Meas./Control/Lab., Industrial Requirements • EN 61000-6-2; Industrial Immunity • EN 61000-6-4; Industrial Emissions • EN 61131-2; Programmable Controllers (Clause 8, Zone A & B) European Union 2006/95/EC LVD, compliant with: • EN 61131-2; Programmable Controllers (Clause 11)
C-Tick	Australian Radiocommunications Act, compliant with: AS/NZS CISPR 11; Industrial Emissions
Ex	European Union 94/9/EC ATEX Directive, compliant with: • EN 60079-15; Potentially Explosive Atmospheres, Protection "n" • EN 60079-0; General Requirements II 3 G Ex nA IIC T4 X
FM	FM Approved Equipment for use in Class I Division 2 Group A,B,C,D Hazardous Locations
TÜV	TÜV Certified for Functional Safety: Capable of SIL 2

(1) When marked. See the Product Certification link at http://www.ab.com for Declarations of Conformity, Certificates, and other certification details.

1756-OF4

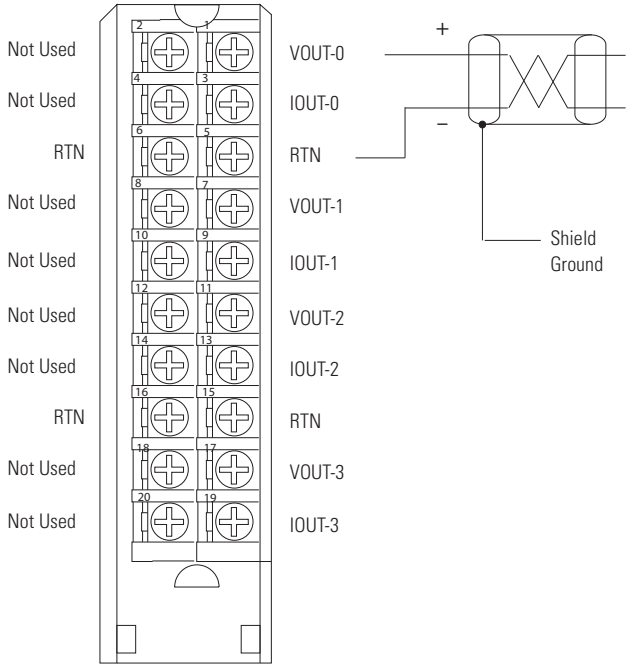
ControlLogix voltage/current output analog module

1756-OF4 Current



- Place additional loop devices (such as strip chart recorders) at the A location noted above.
- Do not connect more than two wires to any single terminal.
- All terminals marked RTN are connected internally.

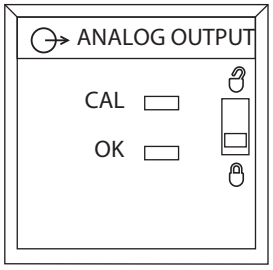
1756-OF4 Voltage



- Do not connect more than two wires to any single terminal.
- All terminals marked RTN are connected internally.

Input Signal to User Count Conversion - 1756-OF4

Range	Low Signal and User Counts	High Signal and User Counts
0...20 mA	0 mA -32768 counts	21.2916 mA 32767 counts
±10V	-10.4336V -32768 counts	10.4336V 32767 counts



Technical Specifications - 1756-OF4

Attribute	1756-OF4
Outputs	8 voltage or current
Output range	±10.4V 0…21 mA
Resolution	Voltage: 15 bits across 10.5V, 320 µV/bit Current: 15 bits across 21mA, 650 nA/bit
Current draw @ 5.1V	150 mA
Current draw @ 24V	120 mA

Technical Specifications - 1756-OF4

Attribute	1756-OF4
Power dissipation, max	3.25 W, 4 channel current
Thermal dissipation	10.91 BTU/hr
Open circuit detection	Current output only (Output must be set to >0.1 mA)
Overvoltage protection	24V DC
Short circuit protection	Electronically current limited to 21mA or less
Drive capability	Voltage: >2000 Ω Current: 0…750 Ω
Settling time	<2 ms to 95% of final value with resistive loads
Calibrated accuracy	4…21 mA, -10.4…10.4V: Better than 0.05% of range @ 25 °C (77 °F)
Calibration interval	12 months
Offset drift	50 µV/ °C 100 nA/°C
Gain drift with temperature	Voltage: 25 ppm/°C, 520 µV/°C Current: 50 ppm/°C, 1050 µA/°C
Module error	Voltage: 0.15% of range Current: 0.3% of range
Module scan time	12 ms floating point 8 ms integer
Isolation voltage	250V (continuous), reinforced insulation type, output channels-to-backplane No isolation between individual output channels Routine tested at 1350V AC for 2 s
Removable terminal block	1756-TBNH 1756-TBSH
Slot width	1
Wire size	0.33…2.1 mm^2 (22…14 AWG) solid or stranded copper wire rated at 90 °C (194 °F), or greater, 1.2 mm (0.047 in.) insulation max(1)
Wire category	2(2)
North American temperature code	T4A
IEC temperature code	T4
Enclosure type	None (open-style)

(1) Maximum wire size requires extended housing, catalog number 1756-TBE.

(2) Use this conductor category information for planning conductor routing as described in the system-level installation manual. See the Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1.

Environmental Specifications - 1756-OF4

Attribute	1756-OF4
Temperature, operating IEC 60068-2-1 (Test Ad, Operating Cold), IEC 60068-2-2 (Test Bd, Operating Dry Heat), IEC 60068-2-14 (Test Nb, Operating Thermal Shock)	0…60 °C (32…140 °F)
Temperature, surrounding air	60 °C (140 °F)
Temperature, storage IEC 60068-2-1 (Test Ab, Unpackaged Nonoperating Cold), IEC 60068-2-2 (Test Bb, Unpackaged Nonoperating Dry Heat), IEC 60068-2-14 (Test Na, Unpackaged Nonoperating Thermal Shock)	-40…85 °C (-40…185 °F)
Relative humidity IEC 60068-2-30 (Test Db, Unpackaged Nonoperating Damp Heat)	5…95% noncondensing
Vibration IEC 60068-2-6 (Test Fc, Operating)	2 g @ 10…500 Hz
Shock, operating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	30 g
Shock, nonoperating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	50 g
Emissions	CISPR 11: Group 1, Class A
ESD Immunity IEC 61000-4-2	6 kV contact discharges 8 kV air discharges
Radiated RF Immunity IEC 61000-4-3	10V/m with 1 kHz sine-wave 80% AM from 80... 2000 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 900 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 1890 MHz 3V/m with 1 kHz sine-wave 80% AM from 2000...2700 MHz
EFT/B Immunity IEC 61000-4-4	±2 kV at 5 kHz on shielded signal ports
Surge Transient Immunity IEC 61000-4-5	±2 kV line-earth (CM) on shielded signal ports
Conducted RF Immunity IEC 61000-4-6	10V rms with 1 kHz sine-wave 80% AM from 150 kHz...80 MHz on shielded signal ports

Certifications - 1756-OF4

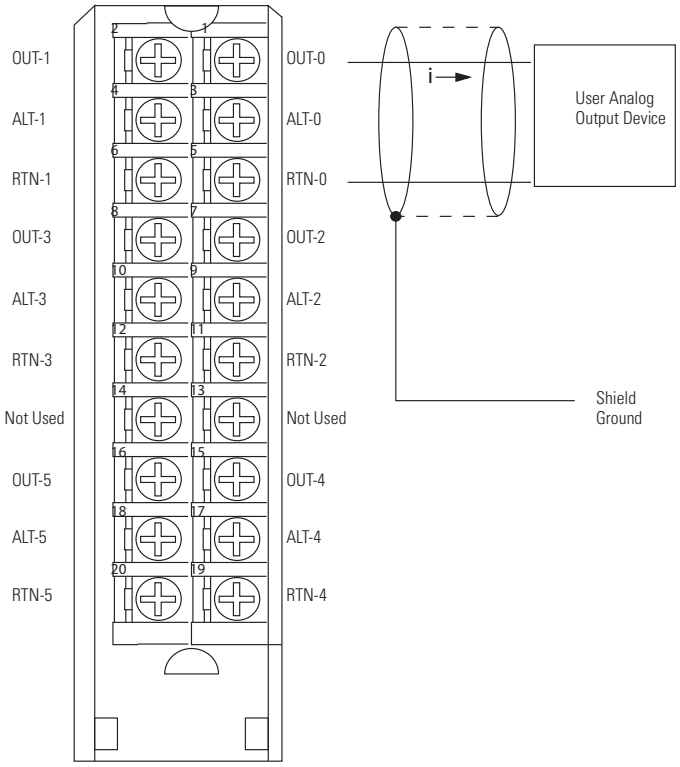
Certification[1]	1756-OF4
UL	UL Listed Industrial Control Equipment, certified for US and Canada. See UL File E65584.
CSA	CSA Certified Process Control Equipment. See CSA File LR54689C. CSA Certified Process Control Equipment for Class I, Division 2 Group A,B,C,D Hazardous Locations. See CSA File LR69960C.
CE	European Union 2004/108/IEC EMC Directive, compliant with: • EN 61326-1; Meas./Control/Lab., Industrial Requirements • EN 61000-6-2; Industrial Immunity • EN 61000-6-4; Industrial Emissions • EN 61131-2; Programmable Controllers (Clause 8, Zone A & B) European Union 2006/95/EC LVD, compliant with: • EN 61131-2; Programmable Controllers (Clause 11)
C-Tick	Australian Radiocommunications Act, compliant with: AS/NZS CISPR 11; Industrial Emissions
Ex	European Union 94/9/EC ATEX Directive, compliant with: • EN 60079-15; Potentially Explosive Atmospheres, Protection "n" • EN 60079-0; General Requirements II 3 G Ex nA IIC T4 X
FM	FM Approved Equipment for use in Class I Division 2 Group A,B,C,D Hazardous Locations

(1) When marked. See the Product Certification link at http://www.ab.com for Declarations of Conformity, Certificates, and other certification details.

1756-OF6CI

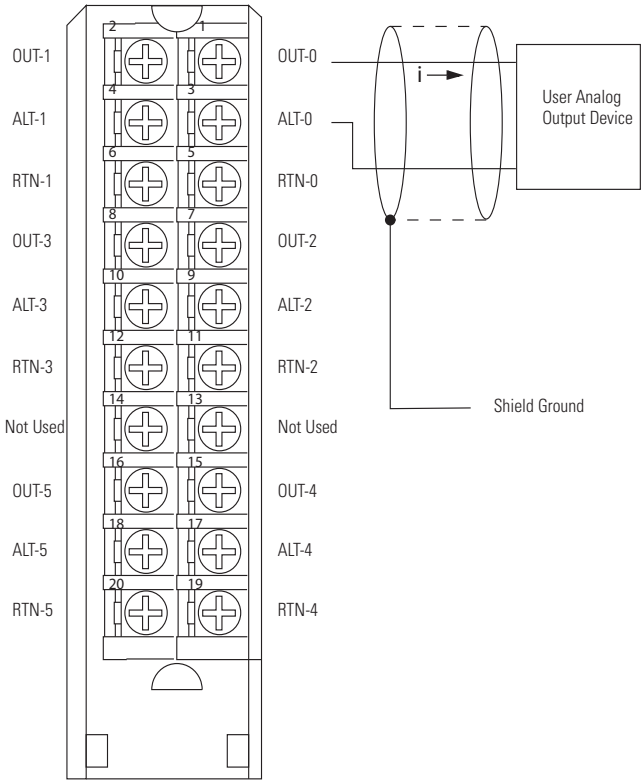
ControlLogix current loop output analog module

1756-OF6CI 0...550 Ω



- Place additional devices anywhere in the loop.
- Do not connect more than two wires to any single terminal.

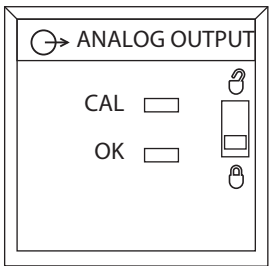
1756-OF6CI 551...1000 Ω



- Place additional devices anywhere in the loop.
- Do not connect more than two wires to any single terminal.

Input Signal to User Count Conversion - 1756-OF6CI

Range	Low Signal and User Counts	High Signal and User Counts
0...20 mA	0 mA -32768 counts	21.074 mA 32767 counts



Technical Specifications - 1756-OF6CI

Attribute	1756-OF6CI
Outputs	6 individually isolated
Output range	0…21 mA
Resolution	13 bits across 21 mA (2.7 μA)
Current draw @ 5.1V	250 mA for 0...550 W loads terminated on OUTs and RTNs (Total backplane power in this range 6.7 W) 250 mA for 551...1000 W loads terminated on OUTs and ALTs (Total backplane power in this range 8.5 W)

Technical Specifications - 1756-OF6CI

Attribute	1756-OF6CI
Current draw @ 24V	225 mA for 0...550 W loads terminated on OUTs and RTNs (Total backplane power in this range 6.7 W) 300 mA for 551...1000 W loads terminated on OUTs and ALTs (Total backplane power in this range 8.5 W)
Power dissipation, max	5.5 W (0…550 Ωloads) 6.1 W (551…1000 Ωloads)
Thermal dissipation	18.76 BTU/hr (0…550 Ωloads) 20.80 BTU/hr (551…1000 Ωloads)
Open circuit detection	None
Overvoltage protection	24V DC
Short circuit protection	Electronically current limited to 21mA or less
Drive capability	0…1000 Ω Separate field terminations for 0…550 Ωand 551…1000 Ω
Settling time	< 2 ms to 95% of final value with resistive loads
Calibrated accuracy	4…21 mA: better than 0.1% of range @ 25 °C (77 °F)
Calibration interval	6 months
Offset drift	1 μA/°C
Gain drift with temperature	60 ppm/°C, 100 ppm/°C max
Module error	0.6% of range
Module scan time	25 ms max floating point 10 ms max integer
Isolation voltage	250V (continuous), basic insulation type, output channels-to-backplane, and output channel-to-channel Routine tested at 1350V AC for 2 s
Removable terminal block	1756-TBNH 1756-TBSH
Slot width	1
Wire size	0.33…2.1 mm^2 (22…14 AWG) solid or stranded copper wire rated at 90 °C (194 °F), or greater, 1.2 mm (0.047 in.) insulation max(1)
Wire category	2(2)
North American temperature code	T4A
IEC temperature code	T4
Enclosure type	None (open-style)

(1) Maximum wire size requires extended housing, catalog number 1756-TBE.

(2) Use this conductor category information for planning conductor routing as described in the system-level installation manual. See the Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1.

Environmental Specifications - 1756-OF6CI

Attribute	1756-OF6CI
Temperature, operating IEC 60068-2-1 (Test Ad, Operating Cold), IEC 60068-2-2 (Test Bd, Operating Dry Heat), IEC 60068-2-14 (Test Nb, Operating Thermal Shock)	0…60 °C (32…140 °F)
Temperature, surrounding air	60 °C (140 °F)
Temperature, storage IEC 60068-2-1 (Test Ab, Unpackaged Nonoperating Cold), IEC 60068-2-2 (Test Bb, Unpackaged Nonoperating Dry Heat), IEC 60068-2-14 (Test Na, Unpackaged Nonoperating Thermal Shock)	-40…85 °C (-40…185 °F)
Relative humidity IEC 60068-2-30 (Test Db, Unpackaged Nonoperating Damp Heat)	5…95% noncondensing
Vibration IEC 60068-2-6 (Test Fc, Operating)	2 g @ 10…500 Hz
Shock, operating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	30 g
Shock, nonoperating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	50 g
Emissions	CISPR 11: Group 1, Class A
ESD Immunity IEC 61000-4-2	6 kV contact discharges 8 kV air discharges
Radiated RF Immunity IEC 61000-4-3	10V/m with 1 kHz sine-wave 80% AM from 80... 2000 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 900 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 1890 MHz 3V/m with 1 kHz sine-wave 80% AM from 2000...2700 MHz
EFT/B Immunity IEC 61000-4-4	±2 kV at 5 kHz on shielded signal ports
Surge Transient Immunity IEC 61000-4-5	±2 kV line-earth (CM) on shielded signal ports
Conducted RF Immunity IEC 61000-4-6	10V rms with 1 kHz sine-wave 80% AM from 150 kHz...80 MHz on shielded signal ports

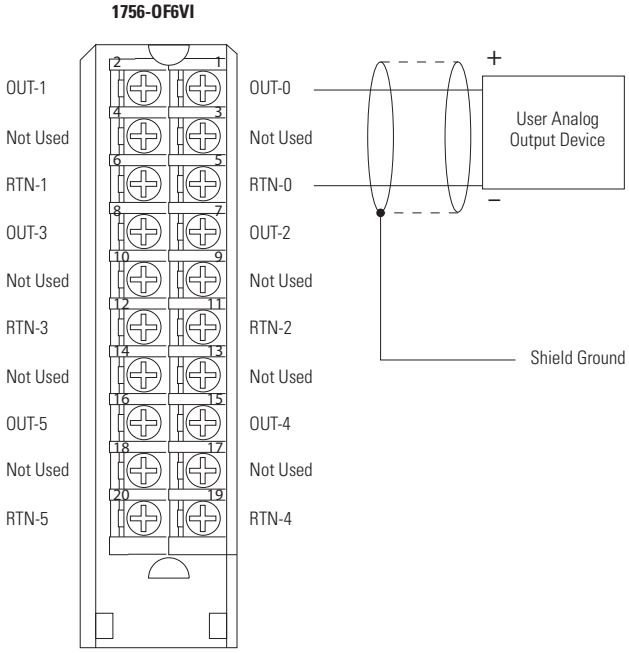
Certifications - 1756-OF6CI

Certification[1]	1756-OF6CI
UL	UL Listed Industrial Control Equipment, certified for US and Canada. See UL File E65584.
CSA	CSA Certified Process Control Equipment. See CSA File LR54689C. CSA Certified Process Control Equipment for Class I, Division 2 Group A,B,C,D Hazardous Locations. See CSA File LR69960C.
CE	European Union 2004/108/IEC EMC Directive, compliant with: • EN 61326-1; Meas./Control/Lab., Industrial Requirements • EN 61000-6-2; Industrial Immunity • EN 61000-6-4; Industrial Emissions • EN 61131-2; Programmable Controllers (Clause 8, Zone A & B) European Union 2006/95/EC LVD, compliant with: • EN 61131-2; Programmable Controllers (Clause 11)
C-Tick	Australian Radiocommunications Act, compliant with: AS/NZS CISPR 11; Industrial Emissions
Ex	European Union 94/9/EC ATEX Directive, compliant with: • EN 60079-15; Potentially Explosive Atmospheres, Protection "n" • EN 60079-0; General Requirements II 3 G Ex nA IIC T4 X
FM	FM Approved Equipment for use in Class I Division 2 Group A,B,C,D Hazardous Locations
TÜV	TÜV Certified for Functional Safety: Capable of SIL 2

(1) When marked. See the Product Certification link at http://www.ab.com for Declarations of Conformity, Certificates, and other certification details.

1756-OF6VI

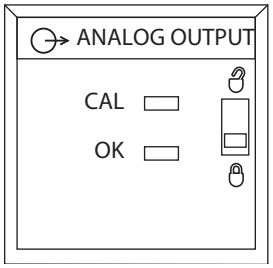
ControlLogix voltage loop output analog module



- Place additional devices anywhere in the loop.
- Do not connect more than two wires to any single terminal.

Input Signal to User Count Conversion - 1756-OF6V

Range	Low Signal and User Counts	High Signal and User Counts
±10V	-10.517V -32768 counts	10.517V 32767 counts



Technical Specifications - 1756-OF6VI

Attribute	1756-OF6VI
Outputs	6 individually isolated
Output range	± 10.5V
Resolution	14 bits across 21V (1.3 mV) (13 bits across 10.5V +sign bit)
Current draw @ 5.1V	250 mA
Current draw @ 24V	175 mA
Power dissipation, max	4.85 W
Thermal dissipation	16.54 BTU/hr
Output impedance	<1 Ω
Open circuit detection	None
Overvoltage protection	24V DC
Short circuit protection	Electronically current limited
Drive capability	> 1000 Ω loads, 10 mA

Technical Specifications - 1756-OF6VI

Attribute	1756-OF6VI
Settling time	< 2 ms to 95% of final value with resistive loads
Calibrated accuracy	4…21 mA: better than 0.1% of range @ 25 °C (77 °F)
Calibration interval	6 months
Offset drift	60 μV/ °C
Gain drift with temperature	50 ppm/°C, 80 ppm/°C max
Module error	0.5% of range
Module scan time	25 ms floating point 10 ms integer
Isolation voltage	250V (continuous), basic insulation type, output channels-to-backplane, and output channel-to-channel Routine tested at 1350V AC for 2 s
Removable terminal block	1756-TBNH 1756-TBSH
Slot width	1
Wire size	0.33…2.1 mm^2 (22…14 AWG) solid or stranded copper wire rated at 90 °C (194 °F), or greater, 1.2 mm (0.047 in.) insulation max(1)
Wire category	2(2)
North American temperature code	T4A
IEC temperature code	T4
Enclosure	None (open-style)

(1) Maximum wire size requires extended housing, catalog number 1756-TBE.

(2) Use this conductor category information for planning conductor routing as described in the system-level installation manual. See the Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1.

Environmental Specifications - 1756-OF6VI

Attribute	1756-OF6VI
Temperature, operating IEC 60068-2-1 (Test Ad, Operating Cold), IEC 60068-2-2 (Test Bd, Operating Dry Heat), IEC 60068-2-14 (Test Nb, Operating Thermal Shock)	0…60 °C (32…140 °F)
Temperature, surrounding air	60 °C (140 °F)
Temperature, storage IEC 60068-2-1 (Test Ab, Unpackaged Nonoperating Cold), IEC 60068-2-2 (Test Bb, Unpackaged Nonoperating Dry Heat), IEC 60068-2-14 (Test Na, Unpackaged Nonoperating Thermal Shock)	-40…85 °C (-40…185 °F)
Relative humidity IEC 60068-2-30 (Test Db, Unpackaged Nonoperating Damp Heat)	5…95% noncondensing
Vibration IEC 60068-2-6 (Test Fc, Operating)	2 g @ 10…500 Hz
Shock, operating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	30 g
Shock, nonoperating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	50 g
Emissions	CISPR 11: Group 1, Class A
ESD Immunity IEC 61000-4-2	6 kV contact discharges 8 kV air discharges

Environmental Specifications - 1756-OF6VI

Attribute	1756-OF6VI
Radiated RF Immunity IEC 61000-4-3	10V/m with 1 kHz sine-wave 80% AM from 80... 2000 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 900 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 1890 MHz 3V/m with 1 kHz sine-wave 80% AM from 2000...2700 MHz
EFT/B Immunity IEC 61000-4-4	±2 kV at 5 kHz on shielded signal ports
Surge Transient Immunity IEC 61000-4-5	±2 kV line-earth (CM) on shielded signal ports
Conducted RF Immunity IEC 61000-4-6	10V rms with 1 kHz sine-wave 80% AM from 150 kHz...80 MHz on shielded signal ports

Certifications - 1756-OF6VI

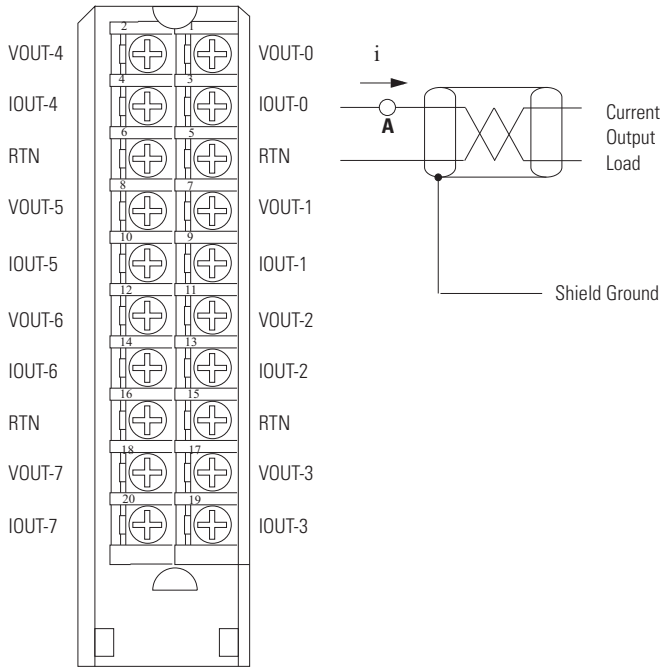
Certification[1]	1756-OF6VI
UL	UL Listed Industrial Control Equipment, certified for US and Canada. See UL File E65584.
CSA	CSA Certified Process Control Equipment. See CSA File LR54689C. CSA Certified Process Control Equipment for Class I, Division 2 Group A,B,C,D Hazardous Locations. See CSA File LR69960C.
CE	European Union 2004/108/IEC EMC Directive, compliant with: • EN 61326-1; Meas./Control/Lab., Industrial Requirements • EN 61000-6-2; Industrial Immunity • EN 61000-6-4; Industrial Emissions • EN 61131-2; Programmable Controllers (Clause 8, Zone A & B) European Union 2006/95/EC LVD, compliant with: • EN 61131-2; Programmable Controllers (Clause 11)
C-Tick	Australian Radiocommunications Act, compliant with: AS/NZS CISPR 11; Industrial Emissions
Ex	European Union 94/9/EC ATEX Directive, compliant with: • EN 60079-15; Potentially Explosive Atmospheres, Protection "n" • EN 60079-0; General Requirements II 3 G Ex nA IIC T4 X
FM	FM Approved Equipment for use in Class I Division 2 Group A,B,C,D Hazardous Locations
TÜV	TÜV Certified for Functional Safety: Capable of SIL 2

(1) When marked. See the Product Certification link at http://www.ab.com for Declarations of Conformity, Certificates, and other certification details.

1756-OF8

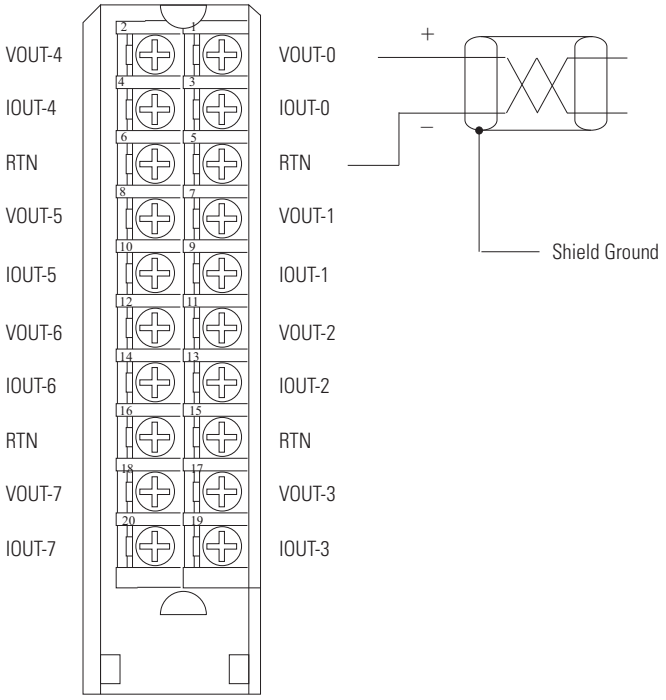
ControlLogix voltage/current output analog module

1756-OF8 Current



- Place additional loop devices (such as strip chart recorders) at the A location noted above.
- Do not connect more than two wires to any single terminal.
- All terminals marked RTN are connected internally.

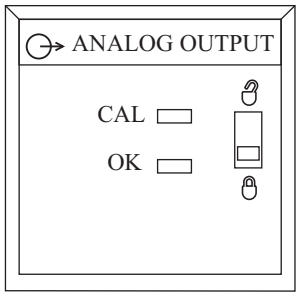
1756-OF8 Voltage



- Do not connect more than two wires to any single terminal.
- All terminals marked RTN are connected internally.

Input Signal to User Count Conversion - 1756-OF8

Range	Low Signal and User Counts	High Signal and User Counts
0...20 mA	0 mA -32768 counts	21.2916 mA 32767 counts
±10V	-10.4336V -32768 counts	10.4336V 32767 counts



Technical Specifications - 1756-OF8

Attribute	1756-OF8
Outputs	8 voltage or current
Output range	± 10.4V 0…21 mA
Resolution	15 bits across 21 mA - 650 nA/bit 15 bits across 10.4V - 320 µV/bit
Current draw @ 5.1V	150 mA

Technical Specifications - 1756-OF8

Attribute	1756-OF8
Current draw @ 24V	210 mA
Power dissipation, max	4.92 W, 4 channel current
Thermal dissipation	16.78 BTU/hr
Open circuit detection	Current output only (Output must be set to >0.1 mA)
Overvoltage protection	24V DC
Short circuit protection	Electronically current limited to 21 mA or less
Drive capability	Voltage: > 2000 Ω Current: 0…750 Ω
Settling time	< 2 ms to 95% of final value with resistive loads
Calibrated accuracy	4…21 mA, -10.4…10.4V: Better than 0.05% of range @ 25 °C
Calibration interval	12 months
Offset drift	50 µV/°C 100 nA/°C1 µA/°C
Gain drift with temperature	Voltage: 25 ppm/°C max Current: 50 ppm/°C max
Module error	Voltage: 0.15% of range Current: 0.3% of range
Module scan time	12 ms min floating point 8 ms min integer
Isolation voltage	250V (continuous), reinforced insulation type, output channels-to-backplane No isolation between individual output channels Routine tested at 1350V AC for 2 s
Removable terminal block	1756-TBNH 1756-TBSH
Slot width	1
Wire size	0.33…2.1 mm^2 (22…14 AWG) solid or stranded copper wire rated at 90 °C (194 °F), or greater, 1.2 mm (0.047 in.) insulation max(1)
Wire category	2(2)
North American temperature code	T4A
IEC temperature code	T4
Enclosure type	None (open-style)

(1) Maximum wire size requires extended housing, catalog number 1756-TBE.

(2) Use this conductor category information for planning conductor routing as described in the system-level installation manual. See the Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1.

Environmental Specifications - 1756-OF8

Attribute	1756-OF8
Temperature, operating IEC 60068-2-1 (Test Ad, Operating Cold), IEC 60068-2-2 (Test Bd, Operating Dry Heat), IEC 60068-2-14 (Test Nb, Operating Thermal Shock)	0…60 °C (32…140 °F)
Temperature, surrounding air	60 °C (140 °F)
Temperature, storage IEC 60068-2-1 (Test Ab, Unpackaged Nonoperating Cold), IEC 60068-2-2 (Test Bb, Unpackaged Nonoperating Dry Heat), IEC 60068-2-14 (Test Na, Unpackaged Nonoperating Thermal Shock)	-40…85 °C (-40…185 °F)
Relative humidity IEC 60068-2-30 (Test Db, Unpackaged Nonoperating Damp Heat)	5…95% noncondensing
Vibration IEC 60068-2-6 (Test Fc, Operating)	2 g @ 10…500 Hz
Shock, operating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	30 g
Shock, nonoperating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	50 g
Emissions	CISPR 11: Group 1, Class A
ESD Immunity IEC 61000-4-2	6 kV contact discharges 8 kV air discharges
Radiated RF Immunity IEC 61000-4-3	10V/m with 1 kHz sine-wave 80% AM from 80... 2000 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 900 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 1890 MHz 3V/m with 1 kHz sine-wave 80% AM from 2000...2700 MHz
EFT/B Immunity IEC 61000-4-4	±2 kV at 5 kHz on shielded signal ports
Surge Transient Immunity IEC 61000-4-5	±2 kV line-earth (CM) on shielded signal ports
Conducted RF Immunity IEC 61000-4-6	10V rms with 1 kHz sine-wave 80% AM from 150 kHz...80 MHz on shielded signal ports

Certifications - 1756-OF8

Certification[1]	1756-OF8
UL	UL Listed Industrial Control Equipment, certified for US and Canada. See UL File E65584.
CSA	CSA Certified Process Control Equipment. See CSA File LR54689C. CSA Certified Process Control Equipment for Class I, Division 2 Group A,B,C,D Hazardous Locations. See CSA File LR69960C.
CE	European Union 2004/108/IEC EMC Directive, compliant with: • EN 61326-1; Meas./Control/Lab., Industrial Requirements • EN 61000-6-2; Industrial Immunity • EN 61000-6-4; Industrial Emissions • EN 61131-2; Programmable Controllers (Clause 8, Zone A & B) European Union 2006/95/EC LVD, compliant with: • EN 61131-2; Programmable Controllers (Clause 11)
C-Tick	Australian Radiocommunications Act, compliant with: AS/NZS CISPR 11; Industrial Emissions
Ex	European Union 94/9/EC ATEX Directive, compliant with: • EN 60079-15; Potentially Explosive Atmospheres, Protection "n" • EN 60079-0; General Requirements II 3 G Ex nA IIC T4 X
FM	FM Approved Equipment for use in Class I Division 2 Group A,B,C,D Hazardous Locations
TÜV	TÜV Certified for Functional Safety: Capable of SIL 2

(1) When marked. See the Product Certification link at http://www.ab.com for Declarations of Conformity, Certificates, and other certification details.

Analog I/O Tag Definitions

The set of tags associated with any module depends on the module type and the communications format. For each operational mode, integer or floating point, there are three sets of tags.

- Input
- Output
- Configuration

Integer Mode Tags

The following tables list the tags that are available on ControlLogix analog modules operating in integer mode.

IMPORTANT Each application's series of tags varies but no input module application contains any tags that are not listed here.

Integer Input Tags

You can view tags from the Controller Organizer in RSLogix 5000 software. To access the Tag Editor, right-click Controller Tags and choose Monitor Tags.

Integer Input Tags

Tag Name	Data Type	Applicable Modules	Definition
ChannelFaults	INT	All	Collection of individual channel fault bits in one word. Can address individual channel fault via bit notation: ex. ChannelFaults 3 for channel 3.
Ch0Fault	BOOL	All	Individual channel fault status bit. Indicates a 'hard' fault has occurred on the channel that means: calibration is ongoing; or if an input, an overrange or underrange condition is present; or if an output, a low or high clamp condition is occurring. These bits also are set by the controller if communication is lost with the I/O module.
ModuleFaults	INT	All	Collection of all module level fault bits.
AnalogGroupFault	BOOL	All	Indicates if a channel fault has occurred on any channel.
InGroupFault	BOOL	All inputs	Indicates if a channel fault has occurred on any input channel.
Calibrating	BOOL	All	Indicates if a calibration is currently in progress on any channel.
CalFault	BOOL	All	Status bit indicating if any channel has a 'bad' calibration. 'Bad' calibration means the last attempt to calibrate the channel failed with an error.
CJUnderrange	BOOL	1756-IT6I and 1756-IT6I2	Status bit to indicate if the cold junction reading is currently beneath the lowest detectable temperature of 0.0 °C (32 °F).

Integer Input Tags

Tag Name	Data Type	Applicable Modules	Definition
CJOverrange	BOOL	1756-IT6I and 1756-IT6I2	Status bit to indicate if the cold junction reading is currently above the highest detectable temperature of 86.0 °C (186 °F).
ChannelStatus	INT	All	Collection of individual channel status bits.
Ch0Underrange	BOOL	All inputs	Alarm bits indicating the channel's input is less than the minimum detectable input signal.
Ch0Overrange	BOOL	All inputs	Alarms bit indicating the channel's input is greater than the maximum detectable input signal.
Ch0Data	INT	All inputs	The channel input signal represented in counts where -32,768 counts is the minimum detectable input signal and 32,767 counts is the maximum detectable.
CJData	INT	1756-IT6I and 1756-IT6I2	The cold junction sensor temperature in counts where -32,768 counts is 0 °C (32 °F) and 32,767 counts is 86 °C (186 °F).
CSTTimestamp	Array of DINT	All (if the CST connection is selected)	Timestamp taken at time the input data was sampled, or if an output when the output was applied, and placed in terms of coordinated system time that is a 64-bit quantity in microseconds coordinated across the rack. Must be addressed in 32-bit chunks as an array.
RollingTimestamp	INT	All	Timestamp taken at time the input data was sampled, or if an output when the output was applied, that is in terms of milliseconds relative solely to the individual module.

Integer Output Tags

Integer Output Tags

Tag Name	Data Type	Applicable Modules	Definition:
Ch0Data	INT	All outputs	The value the channel is to output in counts where the minimum producible output is -32,768 counts and 32,767 counts is the maximum producible.
Ch0DataEcho	INT	All outputs	The value the channel is currently outputting in counts where -32,768 counts is the minimum producible output signal and 32,767 counts is the maximum producible.
OutGroupFault	BOOL	All outputs	Indicates if a channel fault has occurred on any output channel.
Ch0InHold	BOOL	All outputs	Bit that indicates if the output channel is currently holding until the Output value sent to the module (O tag Ch0Data) matches the current output value (I tag Ch0Data) within 0.1% of the channel's full scale.

Integer Configuration Tags

Integer Configuration Tags

Tag Name	Data Type	Applicable Modules	Definition
CJDisable	BOOL	All inputs (only used for the 1756-IT6I and 1756-IT6I2)	Disables the cold junction sensor that turns off cold junction compensation when linearizing thermocouple inputs.
RealTimeSample	INT	All input	Determines how often the input signal is to be sampled in terms of milliseconds.
Ch0RangeNotch	SINT	1756-IF6CIS, 1756-IF6I, 1756-IR6I, 1756-IT6I and 1756-IT6I2	Configures the channel's input range and notch filter settings. The input range is the upper nibble (bits 4…7) and determines the signal range the input channel can detect. Input range values are as listed. 0 = -10…10V (1756-IF6I) 1 = 0…5V (1756-IF6I) 2 = 0…10V (1756-IF6I) 3 = 0…20 mA (1756-IF6CIS and 1756-IF6I) 4 = -12…78 mV (1756-IT6I and 1756-IT6I2) 5 = -12…30 mV (1756-IT6I and 1756-IT6I2) 6 = 1…487 Ω(1756-IR6I) 7 = 2…1,000 Ω (1756-IR6I) 8 = 4…2,000 Ω(1756-IR6I) 9 = 8…4,020 Ω(1756-IR6I) The notch filter provides superior frequency filtering at the selected value and its harmonics. The notch filter is the lowest nibble (bits 0…3). 0 = 10 Hz 1 = 50 Hz 2 = 60 Hz 3 = 100 Hz 4 = 250 Hz 5 = 1,000 Hz
ProgToFaultEn	BOOL	All outputs	The program to fault enable bit determines how the outputs should behave if a communication fault were to occur while the output module is in the Program mode. When set, the bit causes the outputs to transition to their programmed Fault state if a communication fault occurs while in the Program state. If not set, outputs will remain in their configured program state despite a communication fault occurring.
Ch0Config	SINT	All outputs	Contains all individual configuration bits for channel.

Integer Configuration Tags

Tag Name	Data Type	Applicable Modules	Definition
Ch0HoldForInit	BOOL	All outputs	When set configures the channel to hold, or not change, until initialized with a value within 0.1% of full scale of its current value when one of the following conditions occurs. 1 = Module initial connection (power up). 2 = Module transition from Program mode back to Run mode. 3 = Module reestablishes communication after a fault.
Ch0Fault Mode	BOOL	All outputs	Selects the behavior the output channel should take if a communication fault occurs. Either hold last state (0) or go to a user-defined value (1). Ch0FaultValue defines the value to go to on fault if the bit is set.
Ch0ProgMode	BOOL	All outputs	Selects the behavior the output channel when transitioned into Program mode. Either hold last state (0) or go to a user-defined value (1). Ch0ProgValue defines the value to go to on fault if the bit is set.
Ch0RampToProg	BOOL	All outputs	Enables ramping of the output value to a use-defined Program value, Ch0ProgValue, when set. Ramping defines the maximum rate the output is allowed to transition based upon the configured Ch0RampRate.
Ch0RampToFault	BOOL	All outputs	Enables ramping of the output value to a user-defined Fault value, Ch0FaultValue, when set. Ramping defines the maximum rate the output is allowed to transition based upon the configured Ch0RampRate.
Ch0FaultValue	INT	All outputs	Defines the value, in counts, the output should take if a communication fault occurs when the Ch0FaultMode bit is set.
Ch0ProgValue	INT	All outputs	Defines the value, in counts, the output should take when the connection transitions to Program mode if the Ch0ProgMode bit is set.
Ch0RampRate	INT	All outputs	Configures the maximum rate that the output value may change when transitioning to either the Ch0FaultValue or Ch0ProgValue if either the Ch0RampToFault or Ch0RampToProg bits are set, respectively. In terms of percent full-scale per second.

Floating Point Mode Tags

The following tables list the tags that are available on ControlLogix analog modules operating in floating point mode.

IMPORTANT Each application's series of tags varies but no input module application contains any tags that are not listed here.

Floating Point Input Tags

You can view tags from the Controller Organizer in RSLogix 5000 software. To access the Tag Editor, right-click Controller Tags and choose Monitor Tags

Floating Point Input Tags

Tag Name	Data Type	Applicable Modules	Definition
ChannelFaults	INT	All	Collection of individual channel fault bits in one word. Can address individual channel fault via bit notation: ex. ChannelFaults 3 for channel 3.
Ch0Fault	BOOL	All	Individual channel fault status bit. Indicates a 'hard' fault has occurred on the channel that means: calibration is ongoing; or if an input, an overrange or underrange condition is present; or if an output, a low or high clamp condition is occurring. These bits are also set by the controller if communication is lost with the I/O module.
ModuleFaults	INT	All	Collection of all module level fault bits.
AnalogGroupFault	BOOL	All	Indicates if a channel fault has occurred on any channel.
InGroupFault	BOOL	All inputs	Indicates if a channel fault has occurred on any input channel.
Calibrating	BOOL	All	Indicates if a calibration is currently in progress on any channel.
CalFault	BOOL	All	Status bit indicating if any channel has a 'bad' calibration. 'Bad' calibration means the last attempt to calibrate the channel failed with an error and was aborted.
CJUnderrange	BOOL	1756-IT6I and 1756-IT6I2	Status bit to indicate if the cold junction reading is currently beneath the lowest detectable temperature of 0.0 °C (32 °F).
CJOverrange	BOOL	1756-IT6I and 1756-IT6I2	Status bit to indicate if the cold junction reading is currently above the highest detectable temperature of 86.0 °C (186.8 °F).
Ch0Status	INT	All	Collection of individual channel status bits.
Ch0CalFault	BOOL	All inputs	Status bit indicating if the channel has a 'bad' calibration. 'Bad' calibration means the last attempt to calibrate the channel failed with an error and was aborted.
Ch0Underrange	BOOL	All inputs	Alarm bits indicating the channel's input is less than the minimum detectable input signal.

Floating Point Input Tags

Tag Name	Data Type	Applicable Modules	Definition
Ch0Overrange	BOOL	All inputs	Alarms bit indicating the channel's input is greater than the maximum detectable input signal.
Ch0RateAlarm	BOOL	All inputs	Alarm bit that sets when the input channel's rate of change exceeds the configured Ch0ConfigRateAlarmLimit. Remains set until the rate change drops below the configured limit unless latched via Ch0ConfigRateAlarmLatch in the configuration.
Ch0LAlarm	BOOL	All inputs	Low alarm bits that sets when the input signal moves beneath the configured low alarm trigger point, Ch0ConfigLAlarmLimit. Remains set until the input signal moves above the trigger point, unless latched via Ch0ConfigProcAlarmLatch or the input is still within the configured alarm deadband, Ch0ConfigAlmDeadband, of the low alarm trigger point.
Ch0HAlarm	BOOL	All inputs	High alarm bit that sets when the input signal moves above the configured high alarm trigger point, Ch0ConfigHAlarmLimit. Remains set until the input signal moves below the trigger point, unless latched viaCh0ConfigProcAlarmLatch or the input is still within the configured alarm deadband, Ch0ConfigAlmDeadband, of the high alarm trigger point.
Ch0LLAlarm	BOOL	All inputs	Low low alarm bit that sets when the input signal moves beneath the configured low low alarm trigger point, Ch0ConfigLLAlarmLimit. Remains set until the input signal moves above the trigger point, unless latched via Ch0ConfigProcAlarmLatch or the input is still within the configured alarm deadband, Ch0ConfigAlmDeadband, of the low low alarm trigger point.
CH0HHAlarm	BOOL	All inputs	High high alarm bit that sets when the input signal moves above the configured high high alarm trigger point, Ch0ConfigProcAlarmLimit. Remains set until the input signal moves below the trigger point, unless latched via Ch0ConfigAlmDeadband, of the high high alarm trigger point.
Ch0Data	REAL	All inputs	The channel input signal represented in engineering units. The input signal is measured and then scaled based on the user configuration.
CJData	REAL	1756-IT6I and 1756-IT6I2	The cold junction sensor temperature in °C or °F.
CSTTimestamp	Array of DINT	All (if the CST connection is selected)	Timestamp taken at time the input data was sampled, or if an output when the output was applied, and placed in terms of coordinated system time that is a 64-bit quantity in microseconds coordinated across the rack. Must be addressed in 32-bit chunks as an array.
RollingTimestamp	INT	All inputs	Timestamp taken at time the input data was sampled, or if an output when the output was applied, which is in terms of milliseconds relative solely to the individual module.

Floating Point Output Tags

Floating Point Output Tags

Tag Name	Data Type	Applicable Modules	Definition:
Ch0Data	REAL	All outputs	The value the channel is set to output in engineering units based upon the configured scaling for the channel.
Ch0DataEcho	REAL	All outputs	The value the channel is currently outputting in engineering units based upon the configured user scaling. Will match the requested output value, O tag Ch0Data, unless: in Program mode, calibrating, beneath Low Limit, above High Limit, currently ramping or In Hold.
OutGroupFault	BOOL	All outputs	Indicates if a channel fault has occurred on any output channel.
Ch0NotANumber	BOOL	All outputs	Bit indicating the received output value from the controller, O tag Ch0Data, was an invalid IEEE floating point value. When an invalid value is received, the output value holds its last known valid state.
Ch0InHold	BOOL	All outputs	Bit that indicates if the output channel is currently holding until the Output value sent to the module (O tag Ch0Data) matches the current output value (I tag Ch0Data) within 0.1% of the channel's full scale.
CH0RampAlarm	BOOL	All outputs	Alarm bit that sets when the requested output value, Ch0ConfigRampToRun set, and the difference between the new output value requested and the current output exceeds the configured ramp limit, Ch0ConfigMaxRampRate. The bit will remain set until ramping ceases unless the alarm is latched via Ch0ConfigRampAlarmLatch.
Ch0LLimitAlarm	BOOL	All outputs	Alarm bit that sets when the requested output value, Ch0Data, is below the configured low limit, Ch0ConfigLowLimit, in which case the output will stop at the configured low limit which the echo will reflect. Remains set until the requested output moves above the low limit unless latched by Ch0ConfigLimitAlarmLatch.
Ch0HLimitAlarm	BOOL	All outputs	Alarm bit that sets when the requested output value, Ch0Data, is above the configured high limit, Ch0ConfigHighLimit, in which case the output will stop at the configured high limit which the echo will reflect. Remains set until the requested output moves below the high limit unless latched by Ch0ConfigLimitAlarmLatch.

Floating Point Configuration Tags

Floating Point Configuration Tags

Tag Name	Data Type	Applicable Modules	Definition
RemoteTermination	BOOL	1756-IT6I and 1756-IT6I2	Indicates if the cold junction sensor is mounted on a remote termination block when set, rather than on the local terminal block. Needed for proper cold junction compensation when linearizing thermocouples.
CJDisable	BOOL	1756-IT6I and 1756-IT6I2	Disables the cold junction sensor that turns off cold junction compensation when linearizing thermocouple inputs.
TempMode	BOOL	1756-IR6I, 1756-IT6I and 1756-IT6I2	Controls the temperature scale to use on the module. 0 = Celsius 1 = Fahrenheit
ProgToFaultEn	BOOL	All outputs	The program to fault enable bit determines how the outputs should behave if a communication fault occurs while the output module is in the Program mode. When set, the bit causes the outputs to transition to their programmed Fault state if a communication fault occurs while in the Program state. If not set, outputs will remain in their configured Program state despite a communication fault occurring.
RealTimeSample	INT	All input	Determines how often the input signal is to be sampled in terms of milliseconds.
CJOffset	REAL	1756-IT6I and 1756-IT6I2	Provides a user-defined offset to add into the read cold-junction sensor value. Allows a sensor with a built-in bias to be compensated for.
Ch0Config	Struct	All	Master structure beneath which the channel's configuration parameters are set.

Floating Point Configuration Tags

Tag Name	Data Type	Applicable Modules	Definition
Ch0Config RangeTypeNotch	INT	1756-IF6CIS, 1756-IF6I, 1756-IR6I, 1756-IT6I and 1756-IT6I2	Configures the channel's input range, sensor type and notch filter settings. The input range is bits 8…11 and determines the signal range the input channel can detect. Input range values are as listed. 0 = -10…10V (1756-IF6I) 1 = 0…5V (1756-IF6I) 2 = 0…10V (1756-IF6I) 3 = 0…20 mA (1756-IF6CIS and 1756-IF6I) 4 = -12…78 mV (1756-IT6I and 1756-IT6I2) 5 = -12…30 mV (1756-IT6I and 1756-IT6I2) 6 = 1…487 Ω(1756-IR6I) 7 = 2…1,000 Ω (1756-IR6I) 8 = 4…2,000 Ω(1756-IR6I) 9 = 8…4,020 Ω(1756-IR6I) Sensor type is bits 4…7 and selects the sensor type to use for linearization on the 1756-IR6I, IT6I. Sensor types values are as listed. 0 =no linearization, Ω(1756-IR6I), mV (1756-IT6I and 1756-IT6I2) 1 = 100 Ω Platinum 385 (1756-IR6I) B (1756-IT6I and 1756-IT6I2) 2 = 200 ΩPlatinum 385 (1756-IR6I), C (1756-IT6I and 1756-IT6I2) 3 = 500 ΩPlatinum 385 (1756-IR6I), E (1756-IT6I and 1756-IT6I2) 4 = 1000 ΩPlatinum 385 (1756-IR6I), J (1756-IT6I and 1756-IT6I2) 5 = 100 ΩPlatinum 3916 (1756-IR6I), K (1756-IT6I and 1756-IT6I2) 6 = 200 Ω Platinum 3916 (1756-IR6I), N (1756-IT6I and 1756-IT6I2) 7 = 500 Ω Platinum 3916 (1756-IR6I), R (1756-IT6I and 1756-IT6I2) 8 = 1000 ΩPlatinum 3916 (1756-IR6I), S (1756-IT6I and 1756-IT6I2) 9 = 10 Ω Copper 427 (1756-IR6I), T (1756-IT6I and 1756-IT6I2) 10 = 120 ΩNickel 672 (1756-IR6I), TXK/XK (L) (1756-IT6I2) 11 = 100 ΩNickel 618 (1756-IR6I), D (1756-IT6I2) 12 = 120 ΩNickel 618 (1756-IR6I) 13 = 200 Ω Nickel 618 (1756-IR6I) 14 = 500 Ω Nickel 618 (1756-IR6I) The notch filter provides superior frequency filtering at the selected value and its harmonics. The notch filter is the lower nibble (bits 0…3). 0 = 10 Hz 1 = 50 Hz 2 = 60 Hz 3 = 100 Hz 4 = 250 Hz 5 = 1,000 Hz
Ch0ConfigAlarm Disable	BOOL	All	Disables all alarms for the channel.
Ch0ConfigProcess AlarmLatch	BOOL	All inputs	Enables latching for all four process alarms: low, low low, high and high high. Latching causes the process alarm to remain set until an unlatch service is explicitly sent to the channel or alarm.
Ch0ConfigRate AlarmLatch	BOOL	All inputs	Enables latching for the rate alarm. Latching causes the rate alarm to remain set until an unlatch service is explicitly sent to the channel or alarm.
Ch0ConfigDigital Filter	INT	All inputs	A non-zero value enables the filter, providing a time constant in milliseconds used in a first order lag filter to smooth the input signal.

Floating Point Configuration Tags

Tag Name	Data Type	Applicable Modules	Definition
Ch0ConfigTenOhm Offset	INT	1756-IR6I	A value from -100…100 that represents -1.00…1.00 Ω and is an offset used when linearizing a 10 Ω copper sensor type's input.
Ch0ConfigRate AlarmLimit	INT	All inputs	The trigger point for the rate alarm status bit that sets if the input signal changes at a rate faster than the configured rate alarm. Configured in percent full scale per second.
Ch0ConfigLow Signal	REAL	All	One of four points used in scaling. The low signal is in terms of the inputs signal units and corresponds to the low engineering term when scaled. The scaling equation is shown below. $Data = \frac{(Signal - Low\ Signal) \times (High\ Engineering - Low\ Engineering)}{(High\ Signal - Low\ Signal)} + LowEngineering$
Ch0ConfigHigh Signal	REAL	All	One of four points used in scaling. The high signal is in terms of the inputs signal units and corresponds to the high engineering term when scaled. The scaling equation is shown below. $Data = \frac{(Signal - Low\ Signal) \times (High\ Engineering - Low\ Engineering)}{(High\ Signal - Low\ Signal)} + LowEngineering$
Ch0ConfigLow Engineering	REAL	All	One of four points used in scaling. The low engineering helps determine the engineering units the signal values scale into. The low engineering term corresponds to the low signal value. The scaling equation used is shown below. $Data = \frac{(Signal - Low\ Signal) \times (High\ Engineering - Low\ Engineering)}{(High\ Signal - Low\ Signal)} + LowEngineering$
C0ConfigHigh Engineering	REAL	All	One of four points used in scaling. The high engineering helps determine the engineering units the signal values scale into. The high engineering term corresponds to the high signal value. The scaling equation used is shown below. $Data = \frac{(Signal - Low\ Signal) \times (High\ Engineering - Low\ Engineering)}{(High\ Signal - Low\ Signal)} + LowEngineering$
Ch0ConfigLAlarm Limit	REAL	All inputs	The low alarm trigger point. Causes the Ch0LAlarm to trigger when the input signal moves beneath the configured trigger point. In terms of engineering units.
Ch0ConfigHAlarm Limit	REAL	All inputs	The high alarm trigger point. Causes the Ch0HAlarm to trigger when the input signal moves above the configured trigger point. In terms of engineering units.
Ch0ConfigLLAlarm Limit	REAL	All inputs	The low low alarm trigger point. Causes the Ch0LLAlarm to trigger when the input signal moves beneath the configured trigger point. In terms of engineering units.
Ch0ConfigHH AlarmLimit	REAL	All inputs	The high high alarm trigger point. Causes the Ch0HHAlarm to trigger when the input signal moves above the configured trigger point. In terms of engineering units.
Ch0ConfigAlarm Deadband	REAL	All inputs	Forms a deadband around the process alarms that causes the corresponding process alarm status bit to remain set until the input moves beyond the trigger point by greater than the amount of the alarm deadband.
Ch0ConfigCalBias	REAL	All inputs	A user-defined offset added directly into the data, Ch0Data. used to compensate for inherent sensor offset.

Floating Point Configuration Tags

Tag Name	Data Type	Applicable Modules	Definition
Ch0ConfigConfig Bits	INT	All outputs	Collection of channel's individual configuration bits.
Ch0ConfigHoldForInit	BOOL	All outputs	When set configures the channel to hold, or not change, until initialized with a value within 0.1% of full scale of its current value when one of the following conditions occurs. 1 = Module initial connection (power up) 2 = Module transition from Program mode back to Run mode 3 = Module reestablishes communication after a fault
Ch0ConfigRamp AlarmLatch	BOOL	All outputs	Enables latching for the rate alarm. Latching causes the rate alarm to remain set until an unlatch service is explicitly sent to the channel or alarm.
Ch0ConfigLimit AlarmLatch	BOOL	All outputs	Enables latching for the clamp limit alarms. Latching causes the limit alarms to remain set until an unlatch service is explicitly sent to the channel or alarm.
Ch0ConfigFault Mode	BOOL	All outputs	Selects the behavior the output channel should take if a communication fault is to occur. Either hold last state (0) or go to a user-defined value (1). Ch0ConfigFaultValue defines the value to go to on fault if the bit is set.
Ch0ConfigProg Mode	BOOL	All outputs	Selects the behavior the output channel should take when transitioned into Program mode. Either hold last state (0) or go to a user-defined value (1). Ch0ConfigProgValue defines the value to go to on program if the bit is set.
Ch0ConfigRampTo Run	BOOL	All outputs	Enables ramping of the output value during Run mode between the current output level and a newly requested output. Ramping defines the maximum rate the output is allowed to transition based upon the configured Ch0ConfigRampRate.
Ch0ConfigRampToProg	BOOL	All outputs	Enables ramping of the output value to a user-defined program value, Ch0ConfigProgValue, when set. Ramping defines the maximum rate the output is allowed to transition based upon the configured Ch0ConfigRampRate.
Ch0ConfigRampToFaul t	BOOL	All outputs	Enables ramping of the output value to a user-defined Fault value, Ch0FaultValue, when set. Ramping defines the maximum rate the output is allowed to transition based upon the configured Ch0ConfigRampRate.
Ch0ConfigMax RampRate	INT	All outputs	Configures the maximum rate that the output value may change when transitioning to either the Ch0ConfigFaultValue or Ch0ConfigProgValue if either the Ch0ConfigRampToFault or Ch0ConfigRampToProg bits are set, respectively, or in Run mode if Ch0ConfigRampToRun is set. In terms of percent full-scale per second.
Ch0ConfigFault Value	REAL	All outputs	Defines the value, in engineering terms, the output should take if a communication fault occurs when the Ch0ConfigFaultMode bit it set.
Ch0ConfigProg Value	REAL	All outputs	Defines the value, in engineering units, the output should take when the connection transitions to Program mode if the Ch0ConfigProgMode bit is set.
Ch0ConfigLow Limit	REAL	All outputs	Defines the minimum value the output is allowed to take within the process. If an output beneath the low limit is requested, the Ch0LLimit alarm is set and the output signal will remain at the configured low limit.
Ch0ConfigHigh Limit	REAL	All outputs	Defines the maximum value the output is allowed to take within the process. If an output above the high limit is requested, the Ch0HLimit alarm is set and the output signal will remain at the configured high limit.

Notes:

Use Ladder Logic To Perform Run Time Services and Reconfiguration

You can use ladder logic to perform run time services on your module. For example, page 212 explains how to unlatch alarms on the 1756-IF6I module by using RSLogix 5000 software. This appendix provides an example of how to unlatch those same alarms without using RSLogix 5000 software.

In addition to performing run time services, you can use ladder logic to change configuration. Chapter 10 explains how to use the RSLogix 5000 software to set configuration parameters in your ControlLogix analog I/O module. Some of those parameters also may be changed through ladder logic.

Using Message Instructions

In ladder logic, you can use message instructions to send occasional services to any ControlLogix I/O module. Message instructions send an explicit service to the module, causing specific behavior to occur. For example, unlatching a high alarm can be performed by a message instruction.

Message instructions maintain the following characteristics:

- Messages use unscheduled portions of system communication bandwidth
- One service is performed per instruction
- Performing module services does not impede module functionality, such as sampling inputs or applying new outputs

Processing Real-time Control and Module Services

Services sent through message instructions are not as time critical as the module behavior defined during configuration and maintained by a real-time connection. Therefore, the module processes messaging services only after the needs of the I/O connection have been met.

For example, you may want to unlatch all process alarms on the module, but real-time control of your process still is occurring by using the input value from that same channel. Because the input value is critical to your application, the module prioritizes the sampling of inputs ahead of the unlatch service request.

This prioritization allows input channels to be sampled at the same frequency and the process alarms to be unlatched in the time between sampling and producing the real-time input data.

One Service Performed Per Instruction

Message instructions will only cause a module service to be performed once per execution. For example, if a message instruction sends a service to the module to unlatch the high high alarm on a particular channel, that channel's high high alarm will unlatch, but may be set on a subsequent channel sample. The message instruction must then be re-executed to unlatch the alarm a second time.

Create a New Tag

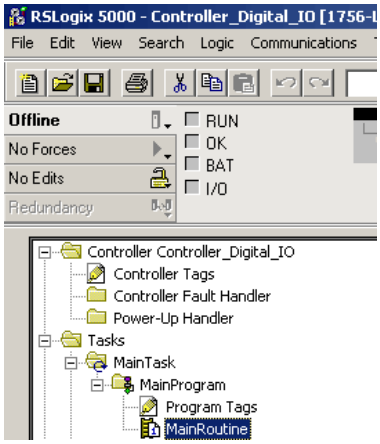
This section shows how to create a tag in ladder logic when adding a message instruction. Ladder logic is written in the Main Routine section of the RSLogix 5000 software program.

Follow these steps to create a tag.

1. Start the RSLogix 5000 software program and open an existing I/O project or create a new one.

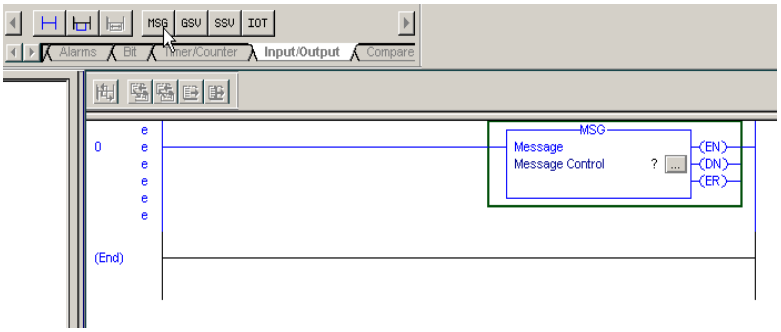
2. On the Controller Organizer, double-click MainRoutine.

   Expand MainProgram to see Main Routine as a sub-menu item.



A graphic that looks like a ladder, with rungs, appears in the right side of the RSLogix 5000 software program. You attach run-time service, such as a message instruction, to the rungs and then download the information to a controller.

You can tell that the rung is in Edit mode because of the 'e' at the left side of the rung.

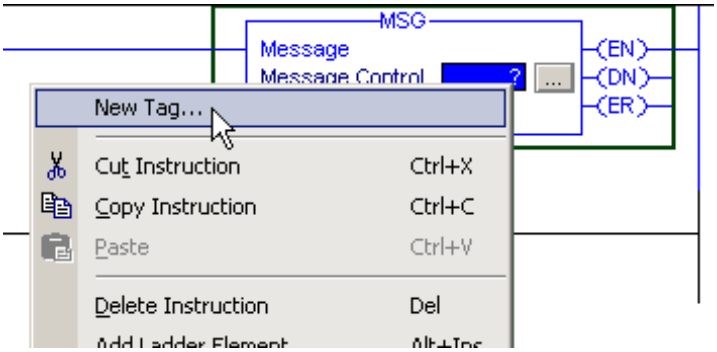


3. Find, then click MSG (message) instruction on the instruction toolbar.

   The MSG icon is among the formats on the Input/Output tab of the instruction toolbar.

   You also can drag-and-drop an instruction icon onto a rung. A green dot appears when a valid location is detected for the instruction on the rung.

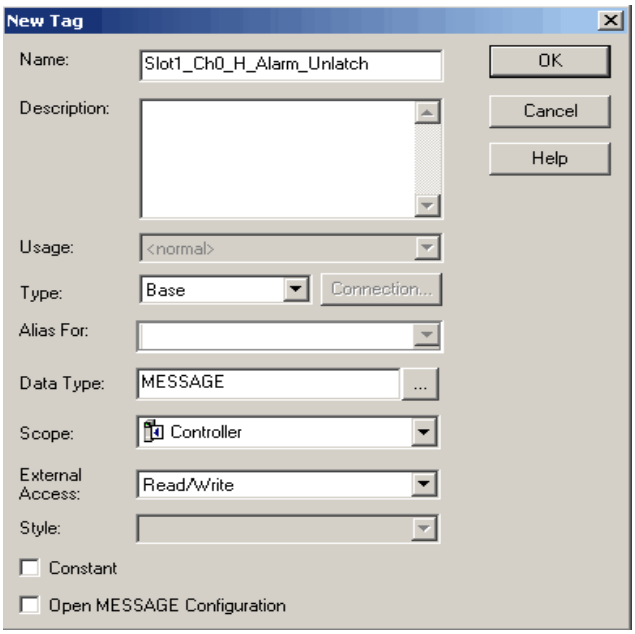
4. Inside the message box (in the Message Control field), right-click the question mark to access a pull-down menu.



5. Choose New Tag.

The New Tag dialog box appears with the cursor in the Name field.

IMPORTANT We suggest you name the tag to indicate what module service the message instruction is sending. For example, if a message instruction is to unlatch a high alarm, then name the tag 'High alarm unlatch' to reflect this.



6. Choose from the options in the New Tag dialog box.

Field Name	Description
Name	Type the tag name, including the slot number in the module.
Description	Type an option tag description.
Usage	Use the default.
Type	Use the default.
Alias for	Leave blank.
Data Type	Choose MESSAGE.
Scope	Choose the Controller scope. **Note:** Message tags can be created only with the Controller scope.
External Access	Use the default.

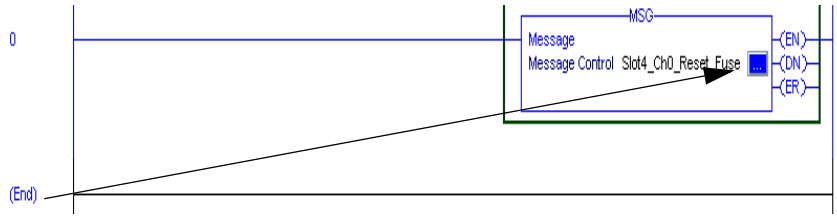
Field Name	Description
Style	Leave blank.
Constant	Leave blank.
Open MESSAGE Configuration	Leave the box blank if you do NOT want to automatically access the Message Configuration screen when OK is clicked. You still can access the Message Configuration screen later by following the procedures on page 344.

7. Click OK.

Enter Message Configuration

After creating a tag, you must enter certain parameters for the message configuration. This information is entered on the Configuration and Communication tabs of the Message Configuration dialog box.

The Message Configuration dialog box is accessed by clicking the box with the ellipses (in the Message Control field).



IMPORTANT

In RSLogix 5000 software, version 10 and later, the Message Configuration dialog boxes changed significantly to make it easier for you to configure your messages.

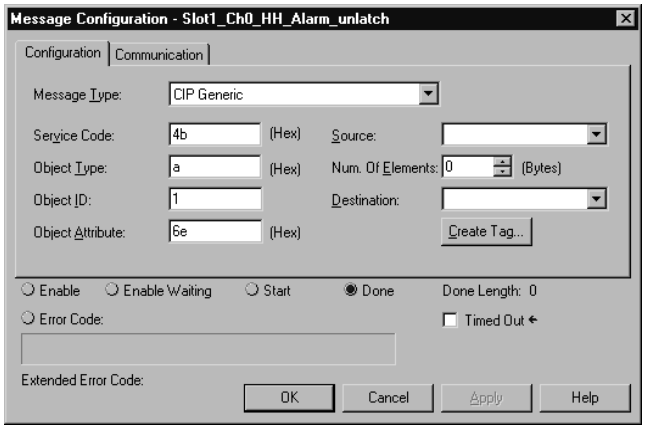
- For example, in **version 9 and earlier**, depending on the Message Type, you are required to configure some combination of the following:
  - Service Code
  - Object Type
  - Object ID
  - Object Attribute
  - Source
  - Number of Elements
  - Destination
- In **version 10 and later**, after you choose a Service Type, RSLogix 5000 software fills in most of the fields listed above. The fields you must fill in are dependent on what Service Type you choose. For example, with the High Alarm Unlatch, you must know only the Source Element and the Destination.

A table describes the relationship of the fields in both dialog boxes on page 345.

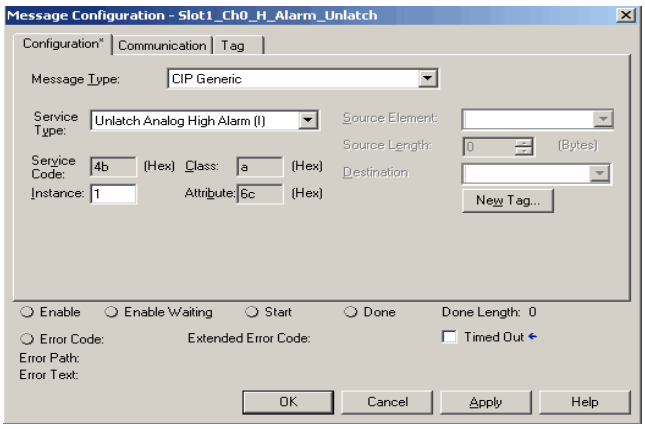
Configuration Tab

The Configuration tab provides information on what module service to perform and where to perform it.

RSLogix 5000 Software, Version 9 and Earlier



RSLogix 5000 Software, Version 10 and Later



The following table explains the relationship of the fields in the above dialog boxes. For example, despite different entry fields, both screen examples are configured to unlatch a high alarm (module service) on channel 0 of a 1756-IF6I module (where to perform the service).

With RSLogix 5000 software versions 10 and later, you are required to choose only a service type and configure the instance.

Relationship of Message Configuration Parameters

RSLogix 5000 Versions 9 and earlier	RSLogix 5000 Versions 10 and later	Description
Service Code	Service Type	Defines the type of module service to be performed. For example, unlatch alarm. **Note:** In versions 10 and later, you can use a pull-down menu to choose the Service Type. RSLogix 5000 software defaults the Service Code, Instance, Class, and Attribute parameters based on the Service Type that you choose. All values are in Hex.

Relationship of Message Configuration Parameters

RSLogix 5000 Versions 9 and earlier	RSLogix 5000 Versions 10 and later	Description
Object Type	Class	Object that you are sending a message to, such as the device object or a discrete output point.
Object ID	Instance	Each object can have multiple instances. For example, a discrete output can have 16 points or instances of where a message can be sent. This specifies the instance.
Object Attribute	Attribute	Further identifies the exact address for the message. An analog input can have multiple alarms so this attribute acknowledges a specific alarm and not the other alarms. If an attribute is not specified (default to 0) the Service applies to all attributes of the Class/Instance.

The following table contains input configuration information that is **necessary only** if you are configuring the message with RSLogix 5000 software, **versions 9 or earlier**.

Analog Input Modules Configuration Dialog Window Information

Enter the following	To unlatch the high high alarm	To unlatch the high alarm	To unlatch the low alarm	To unlatch the low low alarm	To unlatch the rate alarm
Service Code	4B	4B	4B	4B	4B
Object Type	0A	0A	0A	0A	0A
Object ID[1] (Channel Number)	1…6 or 1…8	1…6 or 1…8	1…6 or 1…8	1…6 or 1…8	1…6 or 1…8
Object Attribute	6E	6C	6B	6D	6F
Number of Elements	0 bytes	0 bytes	0 bytes	0 bytes	0 bytes

(1) The 1756-IF16 module does not have any unlatchable features in the 16-channel mode.

IMPORTANT

For input or output modules, the Object Attribute determines which alarm feature for the selected channel to unlatch. If this field is left blank, **all alarms for the selected channel** will be unlatched.

You must send separate message instructions to control specific alarms on each channel of the module.

Also, Object ID represents channel number. For the 1756-IF6I, 1756-IR6I, and 1756-IT6I modules, channels 0…5 are represented by Object ID 1…6. For the 1756-IF16 (in differential mode only) and 1756-IF8 modules, channels 0…7 are represented by Object ID 1…8.

The table contains required output configuration information to perform output module services. This information is only necessary if you are configuring the message with **RSLogix 5000, versions 9 or earlier**:

Analog Output Modules Configuration Dialog Window Information

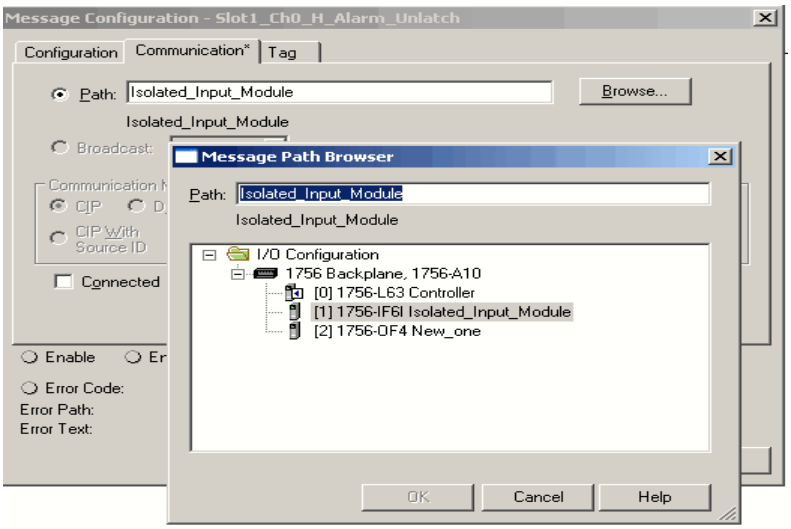
Enter the following	To unlatch the high alarm	To unlatch the low alarm	To unlatch the ramp alarm
Service Code	4B	4B	4B
Object Type	0B	0B	0B
Object ID (Channel Number)	1…6 or 1…8	1…6 or 1…8	1…6 or 1…8
Object Attribute	6F	6E	70
Number of Elements	0 bytes	0 bytes	0 bytes

Communication Tab

The Communication tab provides information on the path of the message instruction. For example, the slot number of a 1756-IF6I module distinguishes exactly which module a message is designated for.

IMPORTANT Use the Brown button to see a list of the I/O modules in the system. You choose a path when you choose a module from the list.

You must name an I/O module during initial module configuration to choose a path for your message instruction. Click OK to set the path.



Unlatch Alarms in the 1756-IF6I Module

Example rungs 0…4 show how to unlatch the following alarms in a 1756-IF6I module, named Slot_1_IF6I.

- Channel 0 High high alarm - Rung 0
- Channel 0 High alarm - Rung 1
- Channel 0 Low alarm - Rung 2
- Channel 0 Low low alarm - Rung 3
- Channel 0 Rate alarm - Rung 4

IMPORTANT

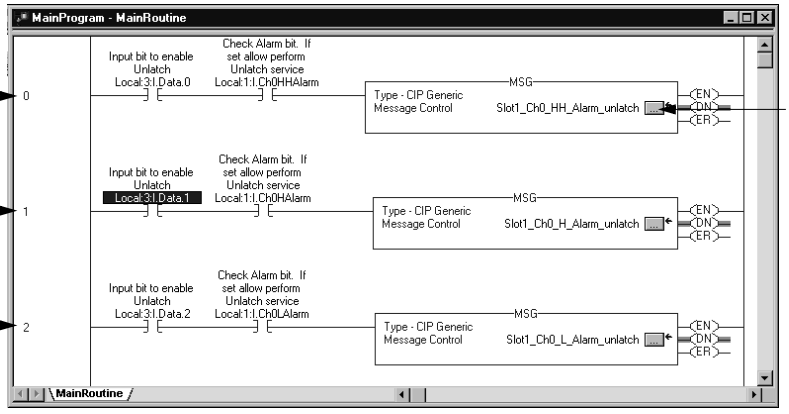
An I/O module must be configured to latch alarms, see page 212 and page 223, before you can perform unlatch services using ladder logic. If an unlatch service is received by a module not configured to latch alarms, the message instruction will error.

Also, all alarms for channel 0 can be unlatched simultaneously with a single message instruction by leaving the object attribute field blank.

Rung 0 unlatches the high high alarm.

Rung 1 unlatches the high alarm.

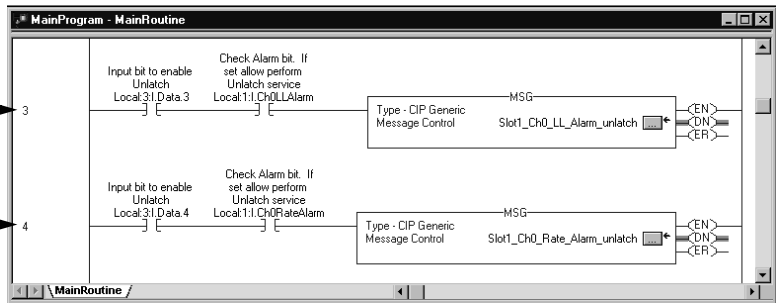
Rung 2 unlatches the low alarm.



Click on the box in each rung to see the configuration and communication information pop-up associated with it. This information is explained on the next page.

Rung 3 unlatches the low low alarm.

Rung 4 unlatches the rate alarm.



Configuration Dialog Boxes

The example below shows the message configuration setting for rung 0 if using RSLogix 5000 software version 9 and earlier

RSLogix 5000 Software, Version 9 and Earlier

This window contains the same information for each rung, except for the Object Attribute field. The information in this field is as follows:

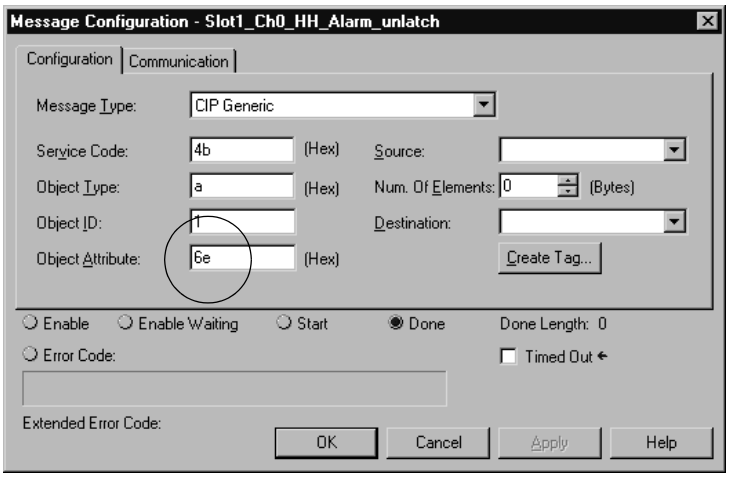
Rung 0 - 6e

Rung 1 - 6c

Rung 2 - 6b

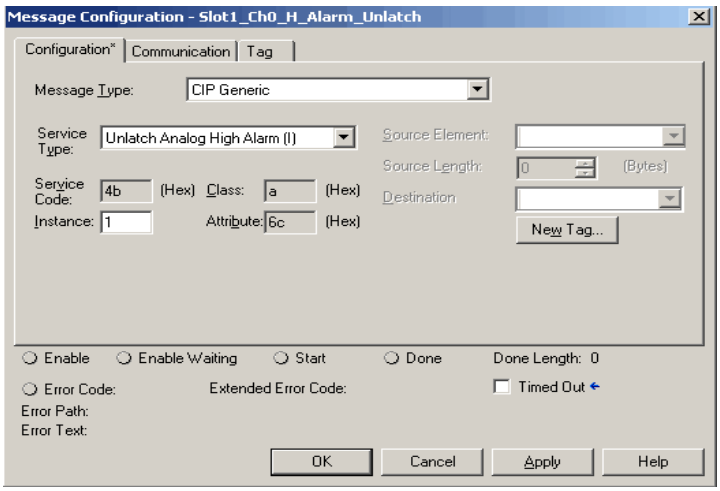
Rung 3 - 6d

Rung 4 - 6f



For the newer versions of RSLogix 5000 software, you are required only to choose a Service Type and configure the Instance.

RSLogix 5000 Software, Version 10 and Later



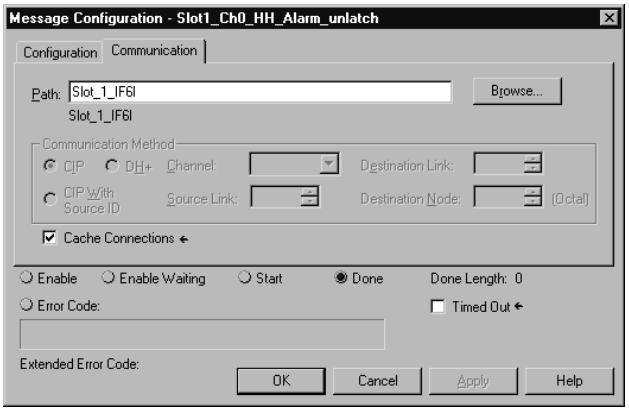
See the table on page 345 for an explanation of the field relationships for the two dialog boxes.

Communication Dialog Boxes

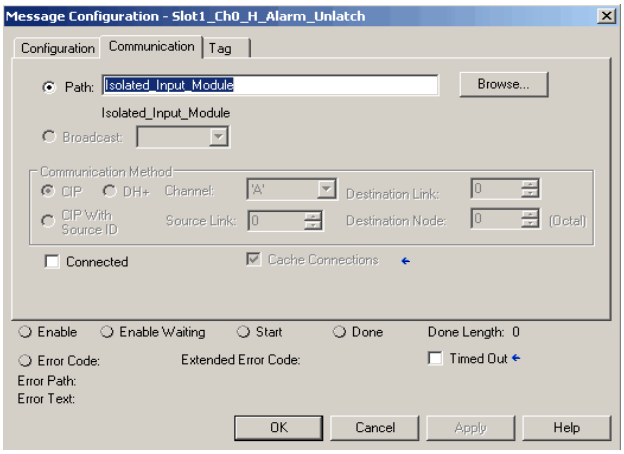
The examples show the Communication dialog boxes for different versions of RSLogix 5000 software.

The top example is for rung 0 if using RSLogix 5000, version 9 and earlier. The window is the same for each rung of this example.

RSLogix 5000 Software, Version 9 and Earlier



RSLogix 5000 Software, Version 10 and Later



IMPORTANT You must name an I/O module to set the message path under that module's communication tab.

Unlatch Alarms in the 1756-OF6VI Module

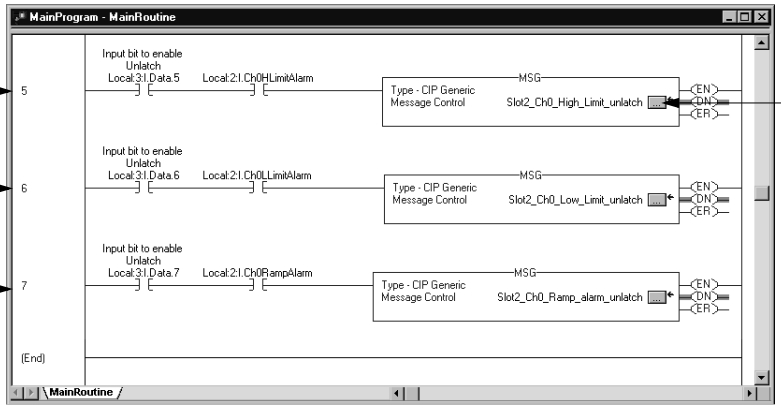
Example rungs 5…7 show how to unlatch the following alarms in a 1756-OF6VI module:

- High limit alarm - Rung 5
- Low limit alarm - Rung 6
- Ramp alarm - Rung 7

Rung 5 unlatches the high limit alarm.

Rung 6 unlatches the low limit alarm.

Rung 7 unlatches the ramp alarm.

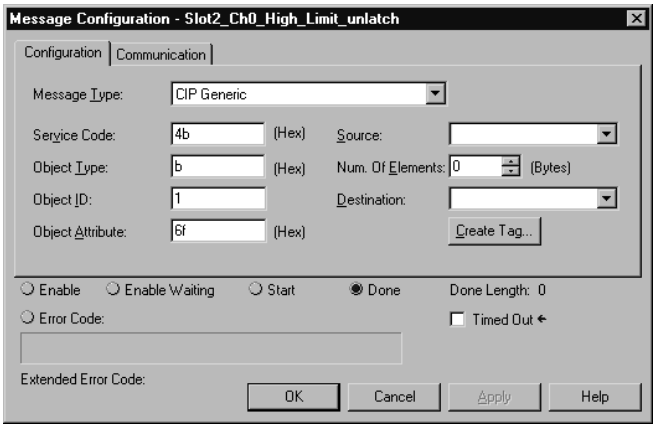


Click on the box in each rung to see the configuration and communication information.

Configuration Dialog Boxes

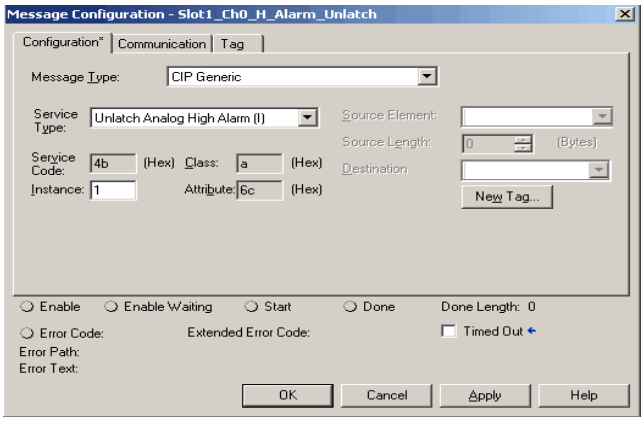
The example dialog box on the left shows the configuration for rung 5. The example dialog box on the right requires only the Service Type and Instance to be entered.

RSLogix 5000 Software, Version 9 and Earlier



This window contains the same information for each rung, except for the Object Attribute field. The information in this field is as follows:
Rung 5 - 6f
Rung 6 - 6e
Rung 7 - 70

RSLogix 5000 Software, Version 10 and Later

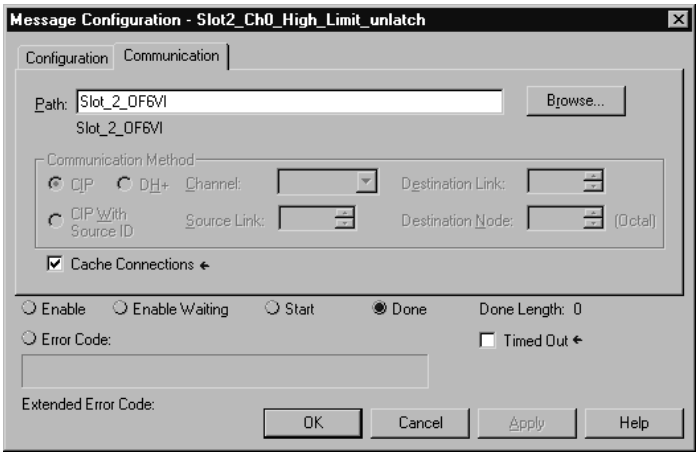


Communication Dialog Boxes

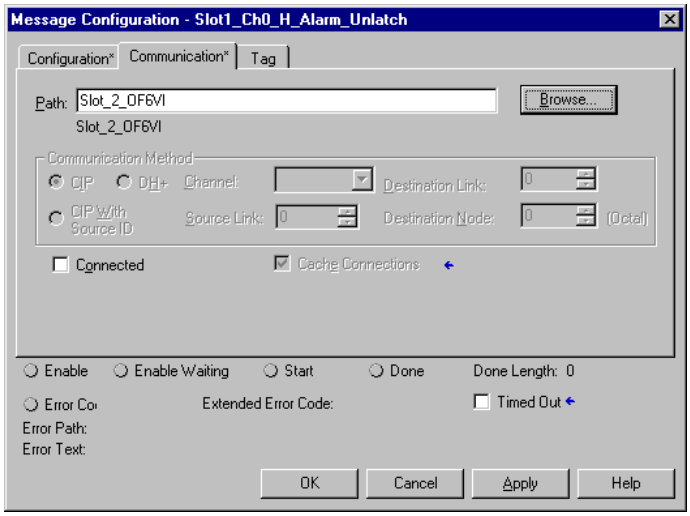
The examples show the Communication dialog boxes for different versions of RSLogix 5000 software.

The top example is for rung 5 if using RSLogix 5000 software, version 9 and earlier. The window is the same for each rung of this example.

RSLogix 5000 Software, Version 9 and Earlier



RSLogix 5000 Software, Version 10 and Later



IMPORTANT You must name an I/O module to set the message path under that module's communication tab.

Reconfiguring a 1756-IR6I Module

It is sometimes advantageous to change the functional operation of a module in the ControlLogix system automatically via the user program rather than using RSLogix5000 software to reconfigure it. This way, changes in the process can dictate when the reconfiguration should take place rather than you performing that function manually.

The following steps are used in this example when reconfiguring a module via ladder logic:

1. Move new configuration parameters to the Configuration portion of the Tag Structure associated with the module.

2. If you are using RSLogix 5000 software, **version 10 or later**, use a message instruction to send a Reconfigure Module service to the same module.

   If you are using RSLogix 5000 software, **version 9 or earlier**, use a message instruction to send a Reset Module service to the same module to trigger sending the configuration data.

Before the new configuration parameters are sent to the module, you must make sure that their relationship to each other is in a format the module will accept (see tables on page 354).

IMPORTANT Reconfiguring analog modules via ladder logic should be limited to functions that involve **only the changing of values**. We do not recommend that enabling or disabling features be done via ladder logic. Use RSLogix 5000 software to enable or disable these features.

The table list module parameters that may be changed via ladder logic.

Permissible Analog Input Module Parameters to Change Via Ladder Logic

Feature	Restriction
High engineering value	Must not be equal to low engineering value
Low engineering value	Must not be equal to high engineering value
High-high alarm value	Must be greater than or equal to high alarm value
High alarm value	Must be greater than low alarm value
Low alarm value	Must be less than high alarm value
Low-low alarm value	Must be less than or equal to low alarm value
Deadband	Must be less than half of high alarm minus low alarm

Permissible Analog Output Module Parameters to Change Via Ladder Logic

Feature	Restriction
High clamp value(1)	Must be greater than low clamp value
Low clamp value(1)	Must be less than high clamp value

(1) The values for user-defined state at Fault or Program (set during initial configuration) must fall within the range of the High and Low clamp values.

Considerations With This Ladder Logic Example

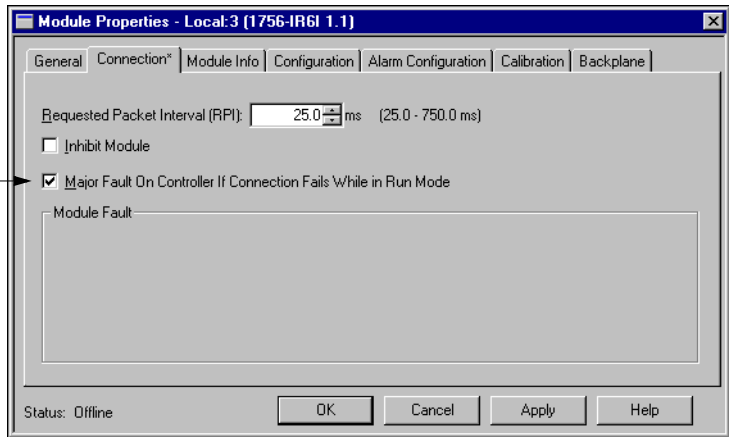
IMPORTANT The considerations listed in this section apply only if you are using RSLogix 5000 software, version 9 or earlier.

If you are using RSLogix 5000 software, **version 10 or later, none of these considerations apply.**

Remember the following when using this method of module reconfiguration using the reset service.

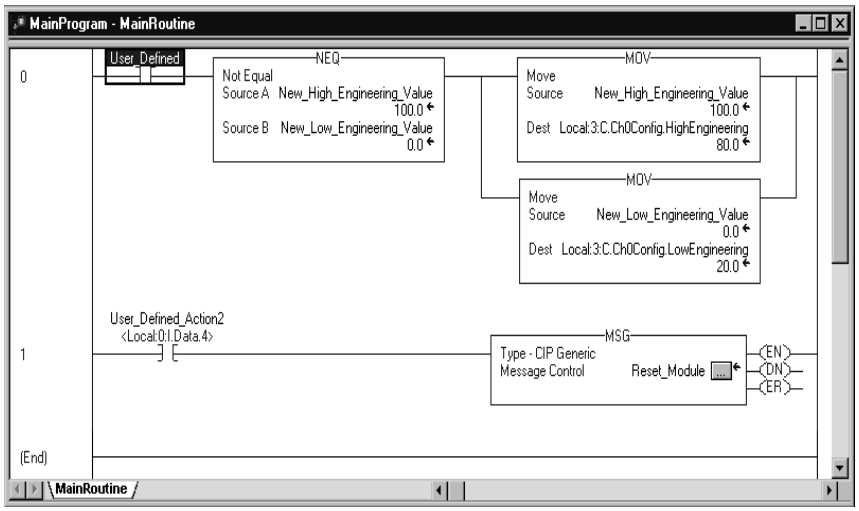
- When this method of reconfiguration is used on output modules, ALL module outputs will be reset to zero for at least three seconds.
- This method of reconfiguration will cause a Major Fault in the controller if the module was initially configured to do so on the following window.

Choose a Major Fault in controller here.



- All Listen-Only controllers will lose their connections to the module for a minimum of three seconds after the Reset is performed.
- If the Reconfiguration is performed on an input module with multiple owners, then all owners will lose their connections simultaneously after the Reset is performed. In order to re-establish all their connections, all owners must change their configuration to the same values BEFORE the Reset is performed.

The following ladder-logic example shows how to change the High and Low engineering values (scaling parameters) for an analog output module in Slot 3 of the local chassis.

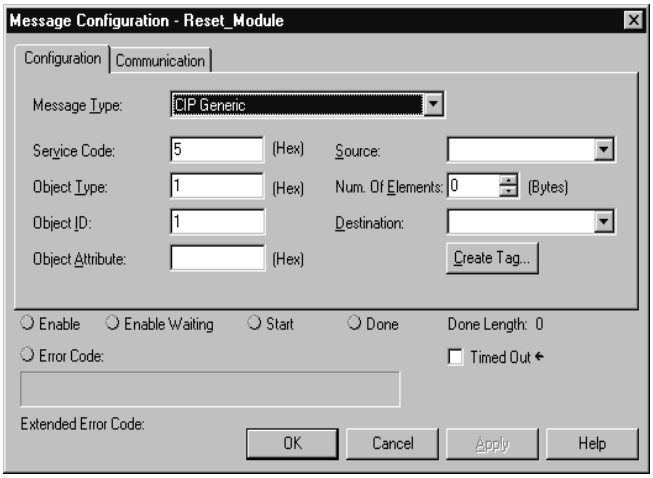


Rung	Description
0	This rung moves new Channel 0 scaling parameters to the configuration portion of the structure associated with an analog output module in Slot 3 of the local chassis. The new values move at the user's discretion (represented by the user defined XIC instruction) after making sure the desired new high value is not equal to the desired new low value. This rung only moves the data to the configuration portion of the structure but does not send it to the module.
1	This rung sends the Reset Module service to the analog output module. Upon receipt, the module will initiate a hardware reset on itself, behaving as though it has just been inserted into the system. A connection is established and the new configuration parameters are sent.

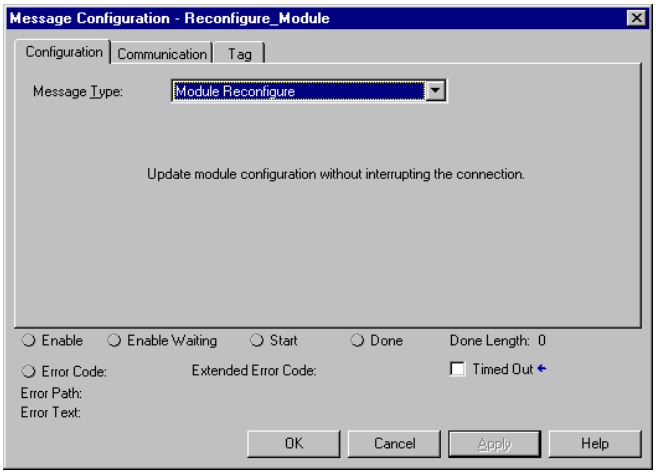
Perform Module Reset Service

The following Message Configuration and Communication dialog boxes show the **message instruction to perform the Reset service** and its path.

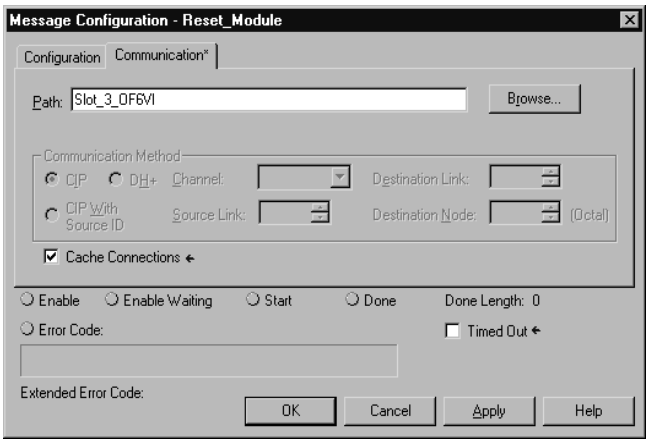
RSLogix 5000 Software, Version 9 and Earlier



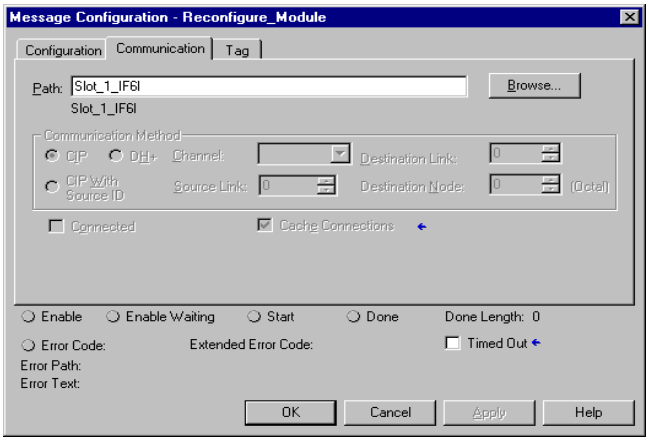
RSLogix 5000 Software, Version 10 and Later



RSLogix 5000 Software, Version 9 and Earlier



RSLogix 5000 Software, Version 10 and Later



Notes:

Choose Correct Power Supply

Power-sizing Chart

You can determine the power that modules contained in a ControlLogix chassis are consuming to maintain an adequate power supply.

An interactive spreadsheet is available that lets you enter a chassis configuration and automatically calculates the total power supply consumption. The total power supply consumption cannot exceed 75 W @ 60 °C (140 °F).

Refer to the configuration spreadsheet in Sizing the ControlLogix Power Supply, Knowledgebase Technical Note ID 22753.

IMPORTANT You must have a support agreement with Rockwell Automation to access the Knowledgebase for technical notes and the power supply configuration spreadsheet.

For more information, contact your local Rockwell Automation distributor or sales representative.

You also can use this worksheet to check power supply consumption. The 5.1 V DC and 24V DC currents are used together to calculate the maximum backplane power dissipation.

Slot Number	Module Cat. No.	Current @ 5.1V DC (mA)		Power @ 5.1V DC (Watts)	Current @ 24V DC (mA)		Power @ 24 V DC (Watts)
0			x 5.1V =			x 24V =	
1			x 5.1V =			x 24V =	
2			x 5.1V =			x 24V =	
3			x 5.1V =			x 24V =	
4			x 5.1V =			x 24V =	
5			x 5.1V =			x 24V =	
6			x 5.1V =			x 24V =	
7			x 5.1V =			x 24V =	
8			x 5.1V =			x 24V =	
9			x 5.1V =			x 24V =	
10			x 5.1V =			x 24V =	
11			x 5.1V =			x 24V =	
12			x 5.1V =			x 24V =	
13			x 5.1V =			x 24V =	
14			x 5.1V =			x 24V =	
15			x 5.1V =			x 24V =	
16			x 5.1V =			x 24V =	
	TOTALS	mA		W	mA		W

The 5.1 V DC current should not exceed: 10 A, 1756-Px72 power supply; 13 A, 1756-Px75 power supply.

Notes:

Additional Specification Information

This appendix offers additional calibration information that may assist you in using the ControlLogix analog I/O module.

Topic	Page
Analog to Digital (A/D) Converter Accuracy	361
Calibrated Accuracy	362
Error Calculated Over Hardware Range	363
How Operating Temperature Changes Affect Module Accuracy	363
RTD and Thermocouple Error Calculations	365
Thermocouple Resolution	373

Analog to Digital (A/D) Converter Accuracy

There are two types of calibration that occur on a ControlLogix analog I/O module.

- The user-directed and user-performed calibration process described in Chapter 11. This type of calibration occurs only when you determine it is necessary and involves an external calibration instrument like those listed on page 234.
- A self-calibration process that takes place internally on ControlLogix analog I/O modules when either of the following events occurs:
  - Module power is cycled.
  - You begin the user calibration described in Chapter 11.

  The 'A/D self-calibration' feature maintains the accuracy of the A/D convertor found on all 1756 isolated analog modules. This feature executes each time the module cycles power or when a self-calibration cycle is initiated.

  The self-calibration compensates for inaccuracies of the on-board reference signal and the A/D convertor only. In other words, the self-calibration feature makes sure that the A/D convertor itself is accurate with respect to its on-board voltage reference that is used for a conversion of the input signal. Together with user calibration, the module's total accuracy is maintained.

Calibrated Accuracy

The **Calibrated Accuracy** specification represents the module's accuracy when its ambient (that is, operating) temperature is the same as the temperature at which the module was calibrated.

Immediately following a calibration, a ControlLogix analog I/O module is most accurate. Because the module was calibrated at its zero and span, the inaccuracy is largely non-linearity between zero and span. Assuming the module is operating at the exact temperature when it was calibrated and uses the same voltage source to check the post-calibration accuracy, a module may be as accurate as 0.01…0.05% of range.

Once the module begins operation, its accuracy lessens as components change over time. However, this change (in components or accuracy) is different from the Gain Drift With Temperature specification described on page 363.

Other than non-linearity, the **Calibrated Accuracy @ 25 °C (77 °F)** specification represents a time drift/aging specification between calibrations. A module with a calibration accuracy of 0.01% of range immediately following calibration is estimated to be better than 0.1% of range @ 25 °C (77 °F) for one year (that is, the calibration cycle).

The reason for the difference between 0.01% and 0.1% of range is that the Calibrated Accuracy @ 25 °C (77 °F) specification must capture the effect of component aging until the next time the module is calibrated. Primarily, the module's operating conditions, such as temperature, humidity, and power cycling, affect component aging.

Because ControlLogix analog I/O modules operate in different conditions, the specific accuracy deviation from 0.01% of range cannot be measured. Typically, however, a module's Calibrated Accuracy @ 25 °C (77 °F) is closer to 0.05% of range than 0.1% of range as the 0.1% of range is determined by the worst case scenario operating conditions.

Error Calculated Over Hardware Range

A ControlLogix analog I/O module's calibration accuracy at 25 °C (77 °F) is calculated over the full hardware range of the module and is not dependent on the application's use of the range. The error is the same if you are measuring it across a 10% or 100% portion of a given range.

However, a module's accuracy at 25 °C (77 °F) is dependent on the hardware range in which the module operates.

EXAMPLE

The 1756-IT6I module offers two input ranges, -12…30 mV and -12 …78 mV. Because module error at 25 °C (77 °F) depends on the input range used, the module error is as follows when using 0.1% of range accuracy:

- +/- 42 mV for the -12…30 mV range
- +/- 90 mV for the -12…78 mV range

These error values are the same whether you use 10% or 100% of the chosen range.

How Operating Temperature Changes Affect Module Accuracy

The following specifications take into account how the module's operating temperature changes can affect a module's accuracy.

- Gain Drift With Temperature
- Module Error Over Full Temperature Range

Gain Drift With Temperature

The **Gain Drift with Temperature** specification represents the calibration inaccuracy that occurs as a module's ambient (that is, operating) temperature drifts from the temperature at which it was calibrated.

You can use the Gain Drift with Temperature specification (varies for each catalog number) to determine the module's calibration inaccuracy for each degree between calibration and operating temperature. The Gain Drift with Temperature specification represents a percentage of the full operating range that the module's calibration is inaccurate to for each degree difference. The specification is determined with the following formula:

Gain Drift with Temperature = (PPM/°C) x Module's Full Range

Because the specifications listed in Appendix A include a typical and worst case PPM/ °C for each module, you can determine multiple Gain Drift with Temperature values for each module.

EXAMPLE

For example, the 1756-IT6I module has a maximum Gain Drift with Temperature specification of 80 ppm/ °C. The 80 ppm represents 0.008% of the module's full operating temperature.

If the module was calibrated to operate in the -12…78mV input range, then following formula is used:

(0.008/ °C) x 90 mV = +/-7.2 µV/ °C

For every degree Celsius that the module's operating temperature moves from the calibration temperature, the maximum calibration accuracy deviation is +/-7.2 µV.

Module Error Over Full Temperature Range

The Module Error Over Full Temperature Range specification represents the error that occurs if the module's ambient temperature changes a total of 60 °C (that is, from 0…60 °C (0…140 °F) or 60…0 °C). While this temperature change is extremely unlikely, it represents the worst case scenario.

This specification is determined by multiplying the temperature change by the maximum Gain Drift with Temperature for the given module. In other words, we determine Module Error Over Full Temperature Range with the following formula:

Module Error Over Full Temperature = Full Temperature Range x Gain Drift with Temperature

EXAMPLE

The 1756-IT6I module has a maximum Gain Drift with Temperature specification = 80 ppm/ °C.

Module Error over Full Temperature Range = 60 °C (full temperature range) X 80 ppm/ °C (gain drift). The result is 4800 ppm or 0.48%.

RTD and Thermocouple Error Calculations

When you use the temperature-measuring modules (1756-IR6I, 1756-IT6I, and 1756-IT6I2), error calculations are achieved in a two-step process.

1. Calculate the module's error in ohms or volts.
2. Convert the ohm/volt error to temperature for the specific sensor and at the correct application temperature.

RTD Error

Module error on the 1756-IR6I module is defined in ohms and is calculated across the entire input range selected, not the available range of a sensor used with the module. For example, if the 1…487 Ω input range is used, the module error is calculated across 507 Ω (actual range = 0.86…507.86 Ω).

The error in ohms translates to temperature, but that translation varies because the relationship is non-linear. The most effective way to check 1756-IR6I module error is to calculate the error in ohms and use that value in a linearization table to check the temperature error.

If the module is calibrated at operating temperature and the operating temperature remains relatively stable, calibration accuracy is better than 0.1% of the full range for the first year after calibration. This 0.1% value is a worst case value. In other words, with the 1…487 Ω input range selected, the worst case module error is 0.507 Ω

Finally, you must check an RTD linearization table to determine the temperature error to which an error of 0.507 Ω translates. For example, if the 1756-IR6I has a 0.1% (or 0.507 Ω) error and is operating at 0 °C (32 °F), the temperature error is -1.25…1.2 °C (29.75…34.16 °F) when the Platinum 385 sensor type is used. However, this same ohms error calculated in an operating temperature of 200 °C (392 °F) translates to a temperature error of -1.4 °C…1.4 °C (29.48…34.52 °F).

Thermocouple Error

Thermocouple error at 25 °C (77 °F) indicates the module's accuracy in measuring temperature. This accuracy varies depending on these factors:

- Input range used, either:
  - -12…30 mV
  - -12…78 mV
- Thermocouple type, any of the following:
  - B, R, S, E, J, K, N, T, L or D (L and D types can be used with the 1756-IT6I2 only)
- Application temperature (that is, the temperature of the physical location where the thermocouple is being used)

EXAMPLE

For example, when the 1756-IT6I module is operating in the following conditions:

- -12…30 mV input range
- connected to a type S thermocouple
- application temperature of 1200 °C (2192 °F)

the module error at 25 °C (77 °F) is +/-1.75 degrees.

In other words, the difference between the temperature the module reports and the actual application temperature can be +/- 1.75 degrees.

The module may report an application temperature of 1200 ° C (2192 °F) in this case when the actual temperature can be in the range from 1196.26…1203.74 ° C (2185.268…2198.732 °F).

IMPORTANT

When determining the thermocouple error, we used a typical error of 0.05% of temperature range. The error calculations are listed for each range (that is, -12…30 mV and -12…78 mV) in the rest of this section.

However, keep in mind that if cold junction compensation is performed on the thermocouple modules, the cold junction sensor error values must be added to the +/-1.75 degrees value in the example above and the numbers listed in the rest of this section.

Module Error at 25 °C (77 °F) (-12…30 mV Range)

The table lists the ControlLogix thermocouple modules' error at 25 °C (77 °F) when used in the -12…30 mV input range.

Application Temperature	Module Error (in degrees) at 25 °C (77 °F) When Connected to This Thermocouple Type							
	B	R	S	E[1]	J[2]	K[3]	N[4]	T
-200 °C (-328 °F)				0.836	0.96	1.376	2.115	1.334
0 °C (32 °F)				0.358	0.42	0.532	0.803	0.542
200 °C (392 °F)		2.37	2.48	0.284	0.38	0.525	0.637	0.395
400 °C (752 °F)		2.02	2.19	0.262	0.38	0.497	0.566	0.340
600 °C (1112 °F)	3.53	1.85	2.06			0.494	0.539	
800 °C (1472 °F)	2.75	1.71	1.93				0.535	
1000 °C (1832 °F)	2.30	1.59	1.82					
1200 °C (2192 °F)	2.03	1.51	1.75					
1400 °C (2552 °F)	1.86	1.49	1.73					
1600 °C (2919 °F)	1.80	1.51	1.77					
1800 °C (3272 °F)	1.83	1.71	2.04					

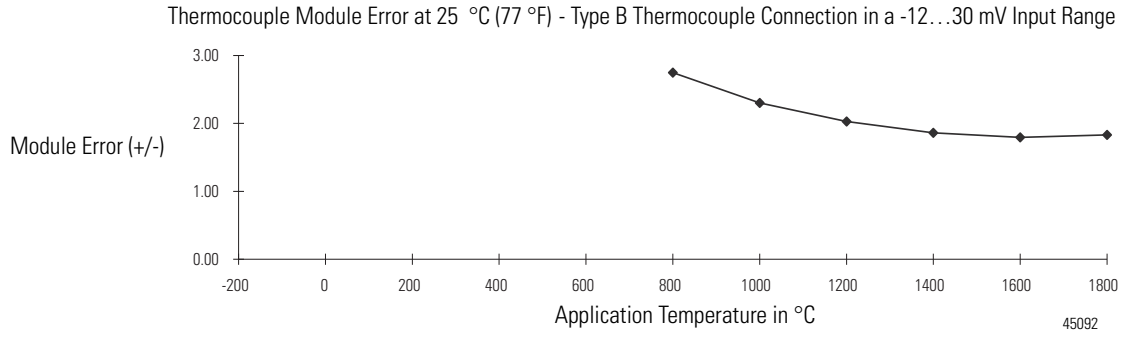
(1) Type E thermocouples can only be used in applications up to 400 °C (752 °F).

(2) Type J thermocouples can only be used in applications up to 550 °C (1022 °F).

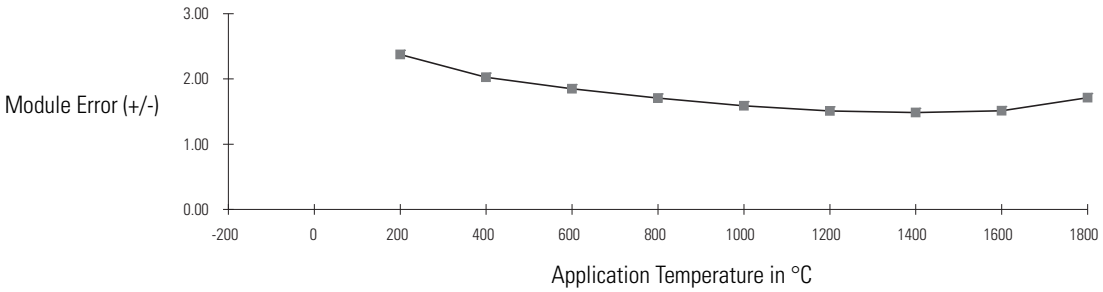
(3) Type K thermocouples can only be used in applications up to 700 °C (1292 °F).

(4) Type N thermocouples can only be used in applications up to 800 °C (1472 °F).

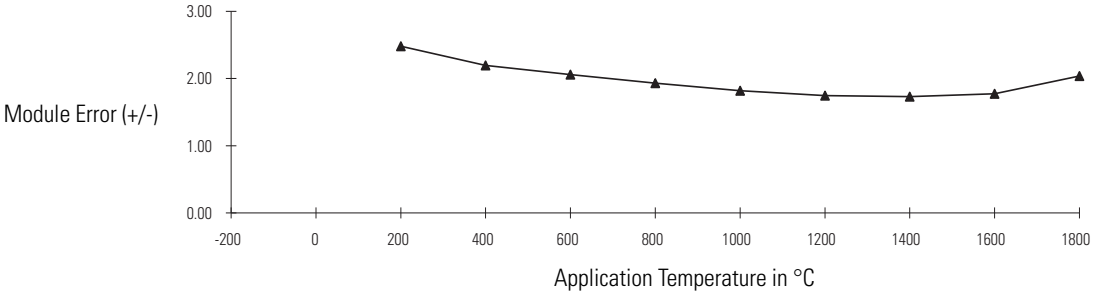
The information represented in the table is shown graphically in the following illustrations.



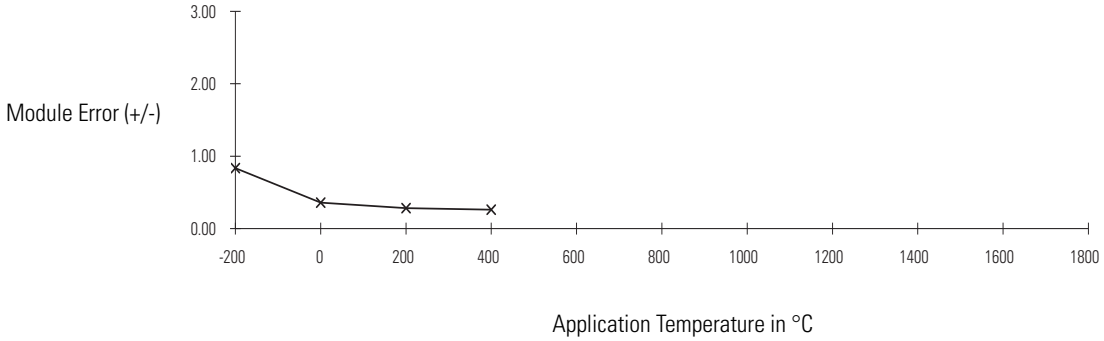
Thermocouple Module Error at 25 °C (77 °F) - Type R Thermocouple Connection in a -12…30 mV Input Range



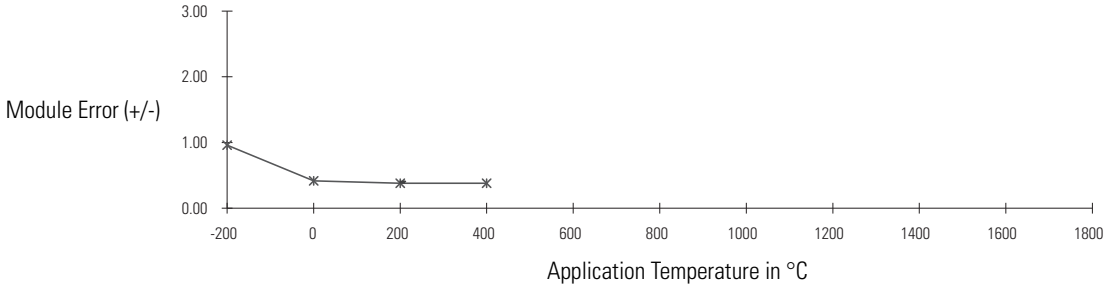
Thermocouple Module Error at 25 °C (77 °F) - Type S Thermocouple Connection in a -12…30 mV Input Range



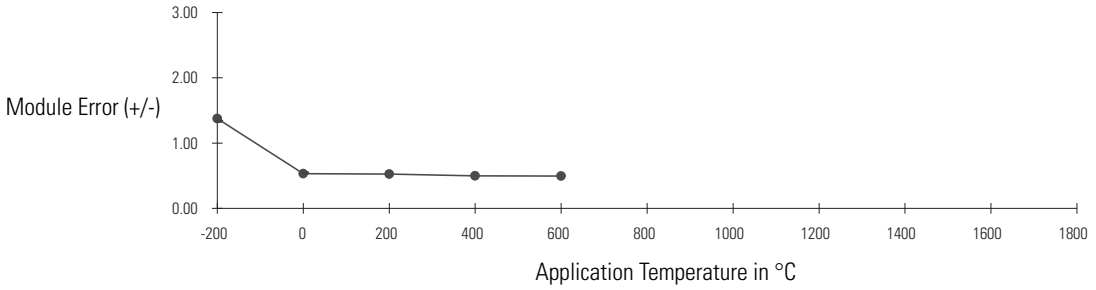
Thermocouple Module Error at 25 °C (77 °F) - Type E Thermocouple Connection in a -12…30 mV Input Range



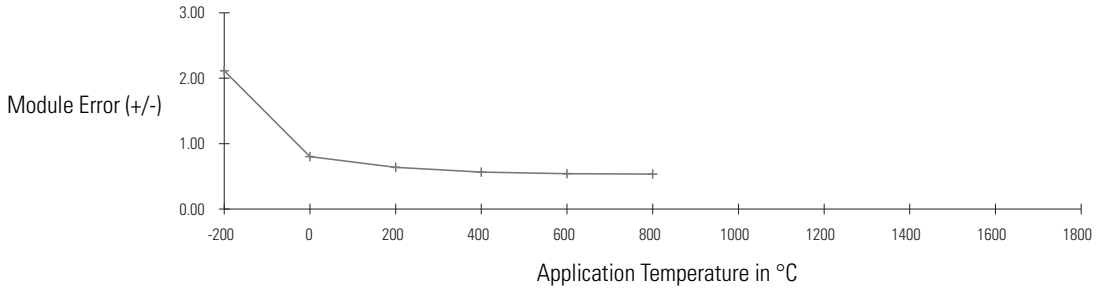
Thermocouple Module Error at 25 °C (77 °F) - Type J Thermocouple Connection in a -12…30 mV Input Range



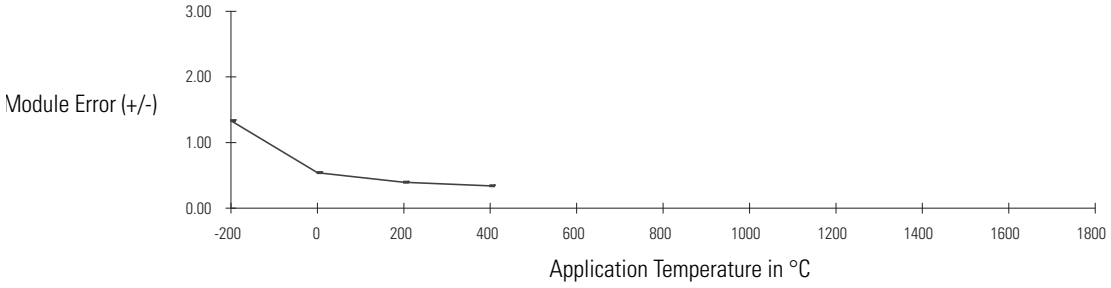
Thermocouple Module Error at 25 °C (77 °F) - Type K Thermocouple Connection in a -12…30 mV Input Range



Thermocouple Module Error at 25 °C (77 °F) - Type N Thermocouple Connection in a -12…30 mV Input Range



Thermocouple Module Error at 25 °C (77 °F) - Type T Thermocouple Connection in a -12…30 mV Input Range

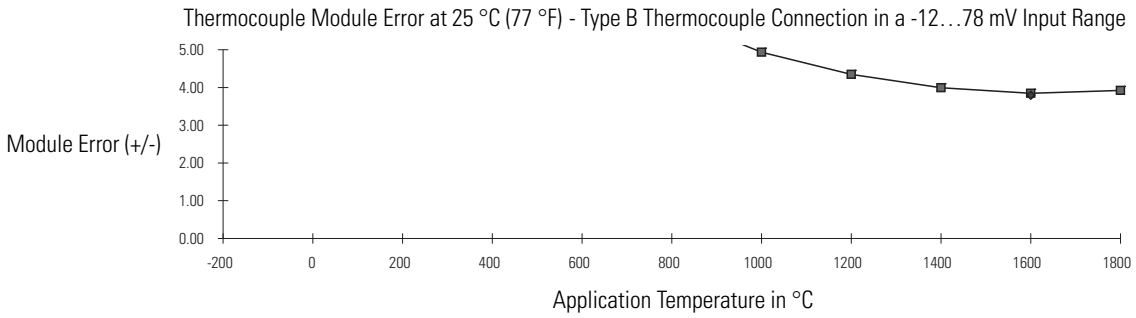


Module Error at 25 °C (77 °F) (-12…78 mV Range)

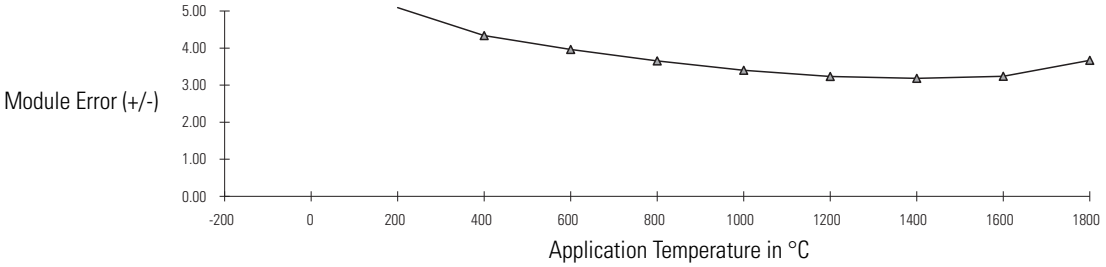
The table lists the ControlLogix thermocouple modules' error at 25 °C (77 °F) when used in the -12…78 mV input range.

Application Temperature	Module Error (in degrees) at 25 °C (77 °F) When Connected to This Thermocouple Type							
	B	R	S	E	J	K	N	T
-200 °C (-328 °F)				1.791	2.06	2.949	4.532	2.859
0 °C (32 °F)				0.767	0.89	1.141	1.720	1.161
200 °C (392 °F)		5.09	5.32	0.608	0.81	1.126	1.364	0.847
400 °C (752 °F)		4.34	4.70	0.562	0.82	1.065	1.212	0.728
600 °C (1112 °F)	7.56	3.96	4.41	0.558	0.77	1.059	1.155	
800 °C (1472 °F)	5.89	3.65	4.14	0.574	0.70	1.098	1.146	
1000 °C (1832 °F)	4.93	3.40	3.90	0.599	0.76	1.154	1.165	
1200 °C (2192 °F)	4.35	3.23	3.74		0.79	1.233	1.210	
1400 °C (2552 °F)	3.99	3.18	3.71			1.328		
1600 °C (2912 °F)	3.85	3.24	3.80					
1800 °C (3272 °F)	3.92	3.67	4.36					

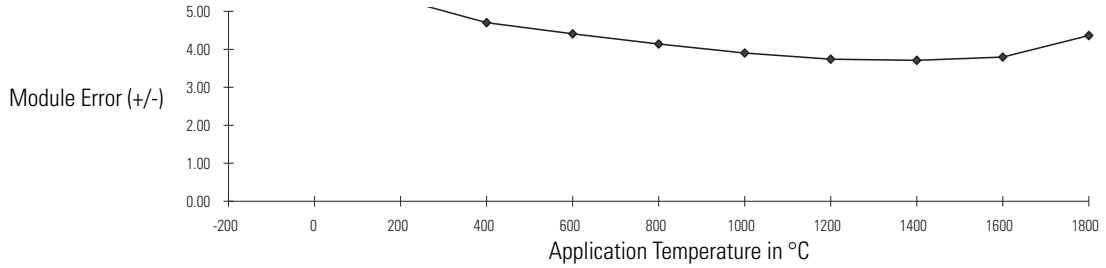
The information represented in the table is shown graphically in the following illustrations.



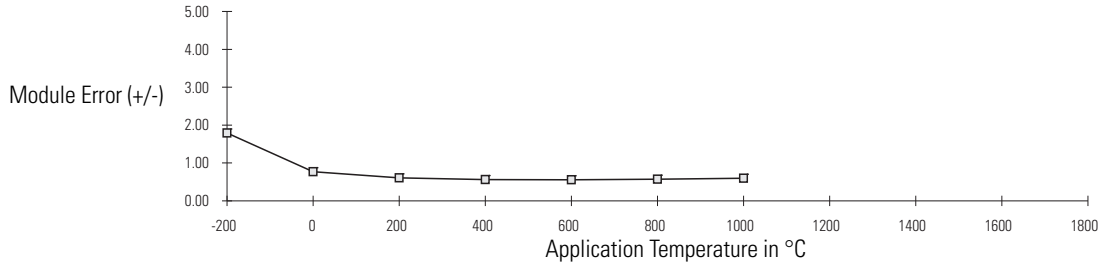
Thermocouple Module Error at 25 °C (77 °F) - Type R Thermocouple Connection in a -12…78 mV Input Range



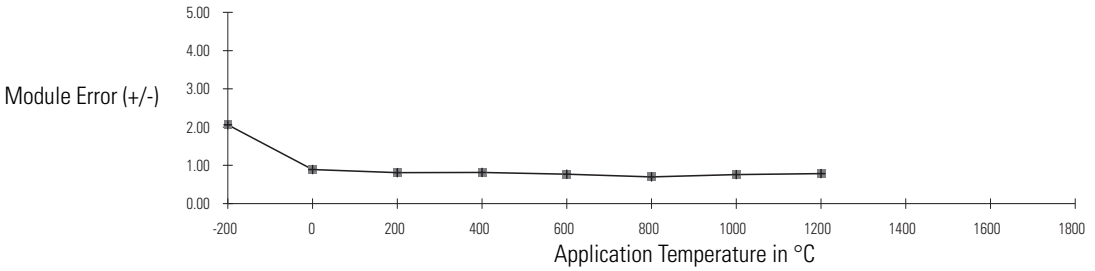
Thermocouple Module Error at 25 °C (77 °F) - Type S Thermocouple Connection in a -12…78 mV Input Range



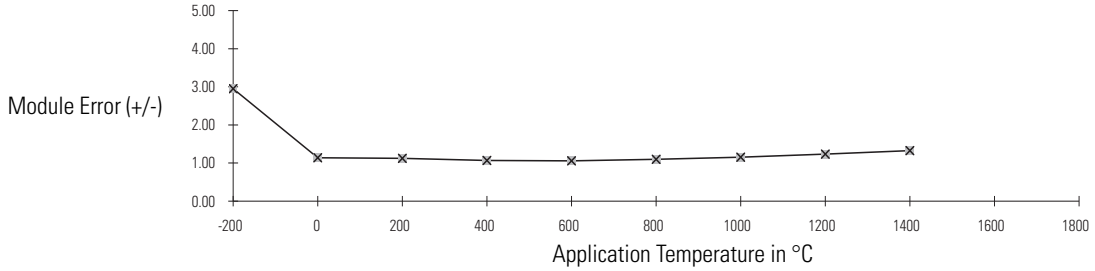
Thermocouple Module Error at 25 °C (77 °F) - Type E Thermocouple Connection in a -12…78 mV Input Range



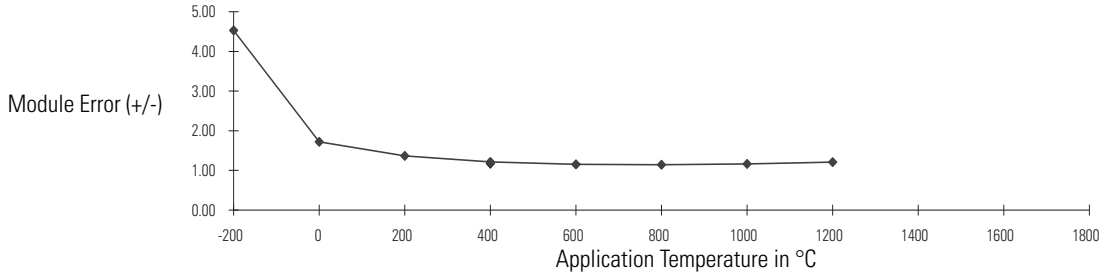
Thermocouple Module Error at 25 °C (77 °F) - Type J Thermocouple Connection in a -12…78 mV Input Range



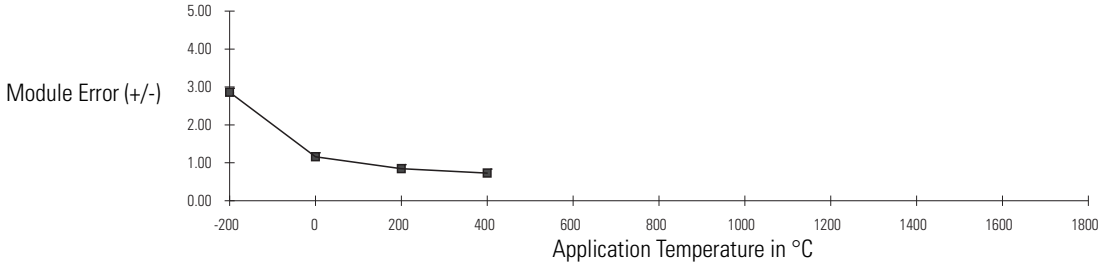
Thermocouple Module Error at 25 °C (77 °F) - Type K Thermocouple Connection in a -12…78 mV Input Range



Thermocouple Module Error at 25 °C (77 °F) - Type N Thermocouple Connection in a -12…78 mV Input Range



Thermocouple Module Error at 25 °C (77 °F) - Type T Thermocouple Connection in a -12…78 mV Input Range



Thermocouple Resolution

Thermocouple resolution indicates the degrees that an application temperature must change before the ControlLogix thermocouple module reports a change. Resolution varies depending on the these factors.

- Input range used, either:
  - -12…30 mV
  - -12…78 mV
- Thermocouple type, any of the following:
  - B, R, S, E, J, K, N, T, L and D (L and D are used on the 1756-IT6I2 module only)
- Application temperature that is, the temperature of the physical location where the thermocouple is being used)

EXAMPLE

For example, when the 1756-IT6I module is operating in the following conditions:

- -12…30 mV input range
- connected to a type K thermocouple
- application temperature of 400 °C (752 °F)

the resolution is 0.017 degrees.

In other words, the application temperature must change by 0.017 degrees or greater for the 1756-IT6I module to record a change. If the temperature stays in a range from 399.984…400.0169 °C (751.971…752.030 °F), the module will continue to report an application temperature of 400 °C (752 °F).

Module Resolution (-12…30 mV Range)

The table lists the resolution of ControlLogix thermocouple modules when used in the -12…30 mV input range.

Application Temperature	Module Resolution (in degrees) When Connected to This Thermocouple Type							
	B	R	S	E[1]	J[2]	K[3]	N[4]	T
-200 °C (-328 °F)				0.028	0.032	0.046	0.071	0.044
0 °C (32 °F)		0.13	0.13	0.012	0.014	0.018	0.027	0.018
200 °C (392 °F)		0.08	0.08	0.009	0.013	0.018	0.021	0.013
400 °C (752 °F)	0.17	0.07	0.07	0.009	0.013	0.017	0.019	0.011
600 °C (1112 °F)	0.12	0.06	0.07			0.016	0.02	
800 °C (1472 °F)	0.09	0.06	0.06				0.02	
1000 °C (1832 °F)	0.08	0.05	0.06					
1200 °C (2192 °F)	0.07	0.05	0.06					
1400 °C (2552 °F)	0.06	0.05	0.06					
1600 °C (2919 °F)	0.06	0.05	0.06					
1800 °C (3272 °F)	0.06	0.06	0.07					

(1) Type E thermocouples can only be used in applications up to 400 °C (752 °F).

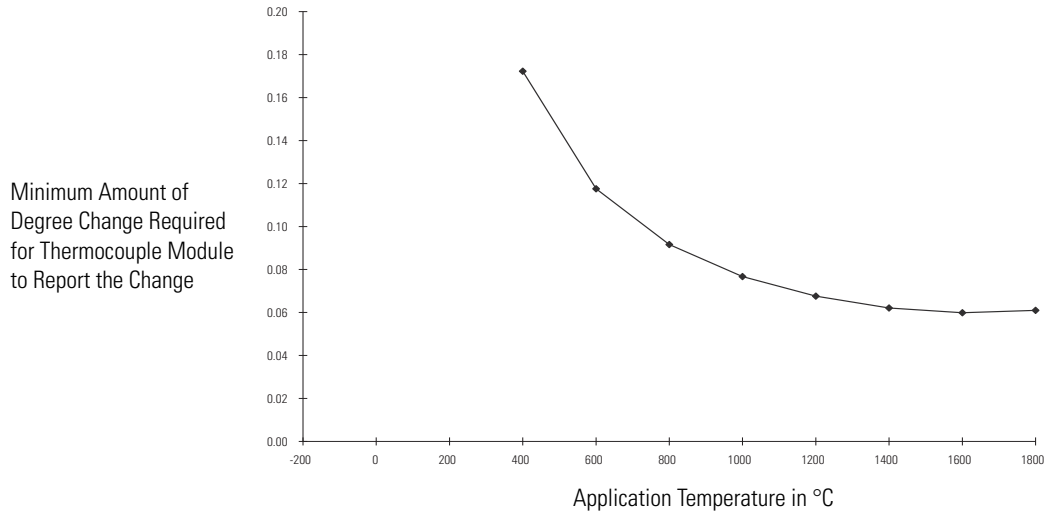
(2) Type J thermocouples can only be used in applications up to 550 °C (1022 °F).

(3) Type K thermocouples can only be used in applications up to 700 °C (1292 °F).

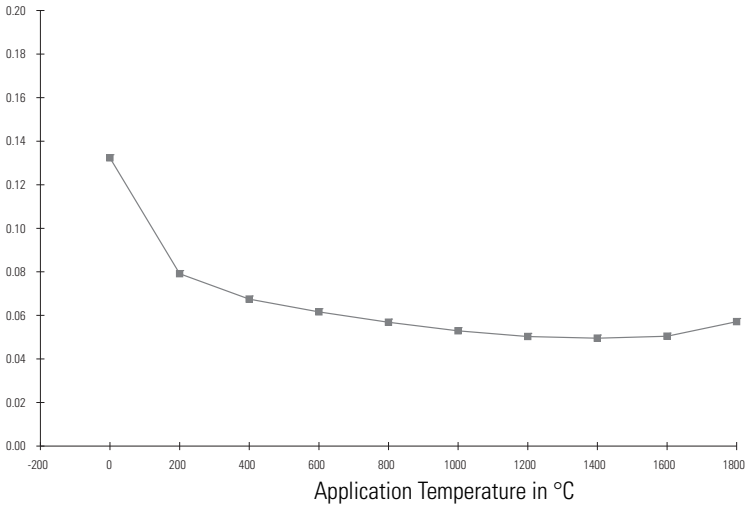
(4) Type N thermocouples can only be used in applications up to 800 °C (1472 °F).

The information represented in the table is shown graphically in the following illustrations.

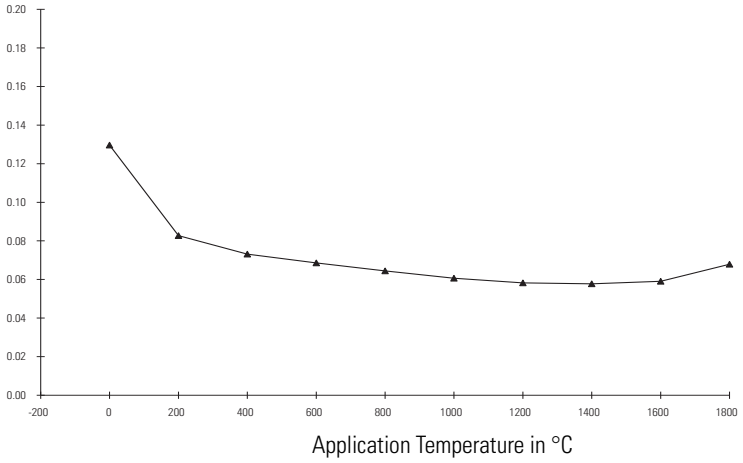
Thermocouple Module Resolution - Type B Thermocouple Connection in a -12…30 mV Input Range



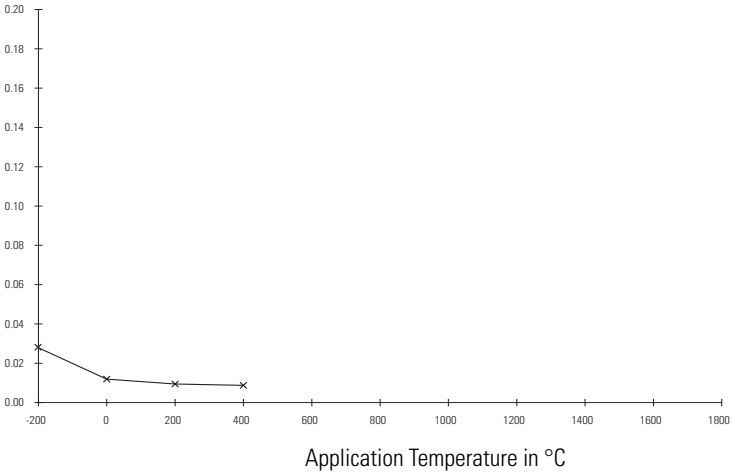
Thermocouple Module Resolution - Type R Thermocouple Connection in a -12…30 mV Input Range



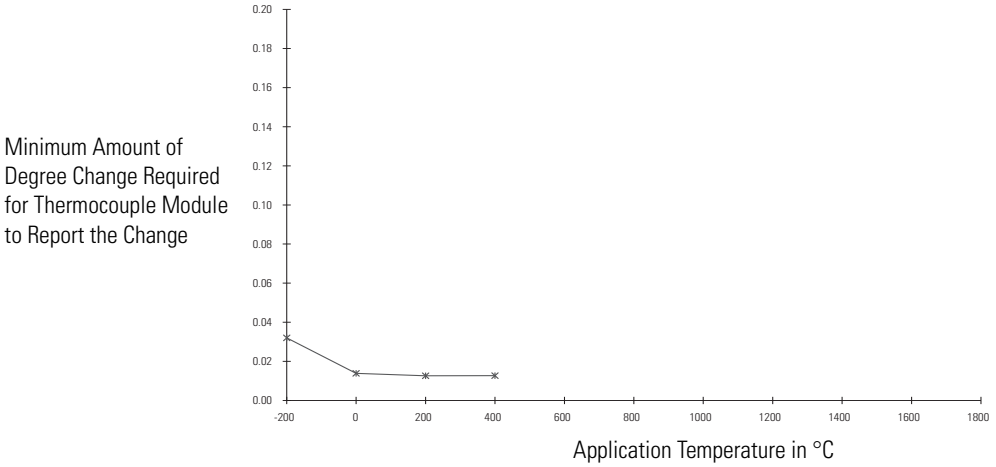
Thermocouple Module Resolution - Type S Thermocouple Connection in a -12…30 mV Input Range



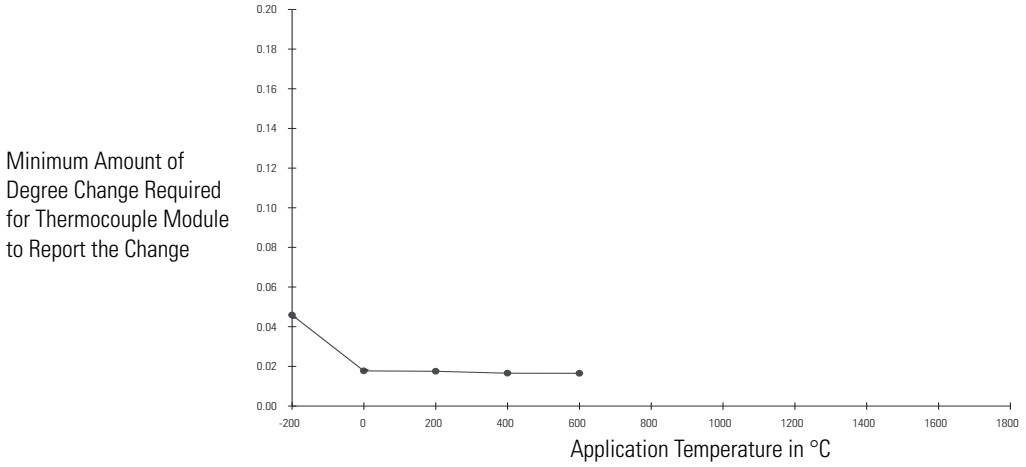
Thermocouple Module Resolution - Type E Thermocouple Connection in a -12…30 mV Input Range



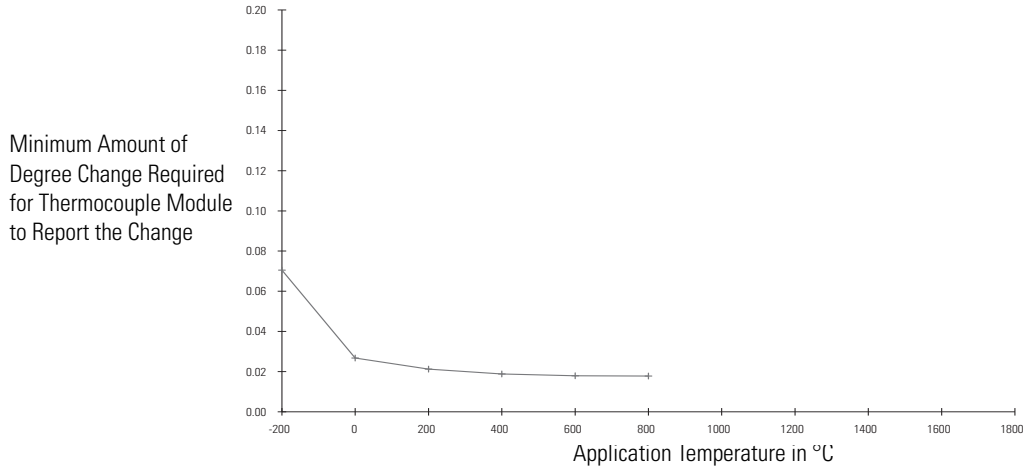
Thermocouple Module Resolution - Type J Thermocouple Connection in a -12…30 mV Input Range



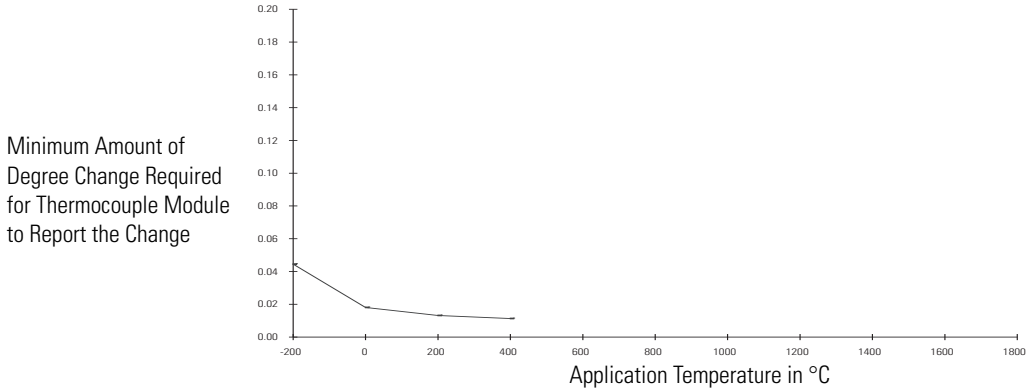
Thermocouple Module Resolution - Type K Thermocouple Connection in a -12…30 mV Input Range



Thermocouple Module Resolution - Type N Thermocouple Connection in a -12…30 mV Input Range



Thermocouple Module Resolution - TypeT Thermocouple Connection in a -12…30 mV Input Range



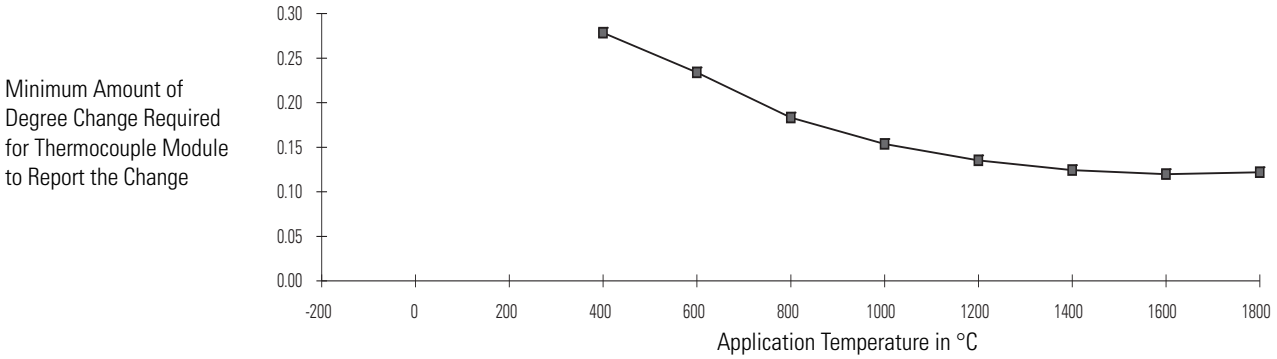
Module Resolution (-12…78 mV Range)

The table lists the resolution of ControlLogix thermocouple modules when used in the -12…78 mV input range.

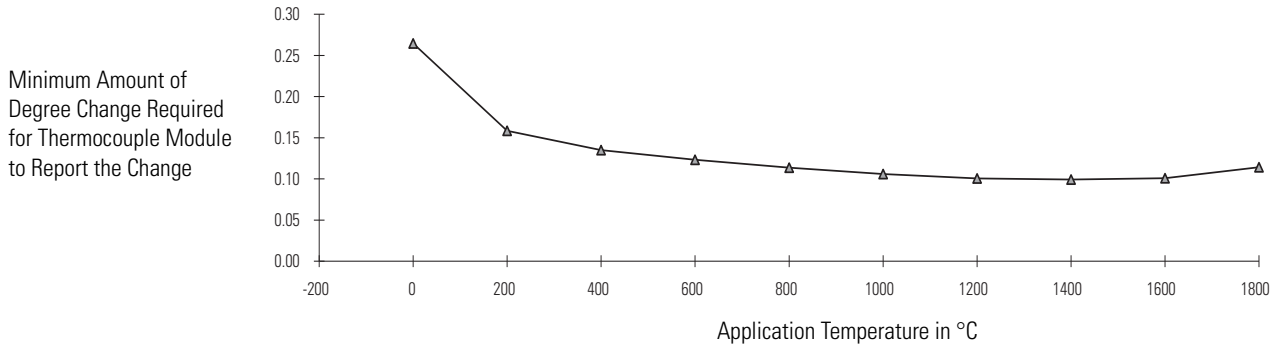
Application Temperature	Module Resolution (in degrees) When Connected to This Thermocouple Type							
	B	R	S	E	J	K	N	T
-200 °C (-328 °F)				0.056	0.064	0.046	0.141	0.089
0 °C (32 °F)		0.26	0.26	0.024	0.028	0.092	0.054	0.036
200 °C (392 °F)		0.16	0.17	0.019	0.025	0.035	0.042	0.026
400 °C (752 °F)	0.28	0.14	0.15	0.017	0.025	0.035	0.038	0.023
600 °C (1112 °F)	0.23	0.12	0.14	0.017	0.024	0.033	0.04	
800 °C (1472 °F)	0.18	0.11	0.13	0.018	0.022	0.033	0.04	
1000 °C (1832 °F)	0.15	0.11	0.12	0.019	0.024	0.034	0.04	
1200 °C (2192 °F)	0.14	0.10	0.12		0.024	0.036	0.04	
1400 °C (2552 °F)	0.12	0.10	0.12			0.038		
1600 °C (2912 °F)	0.12	0.10	0.12					
1800 °C (3272 °F)	0.12	0.11	0.14					

The information represented in the table is shown graphically in the following illustrations.

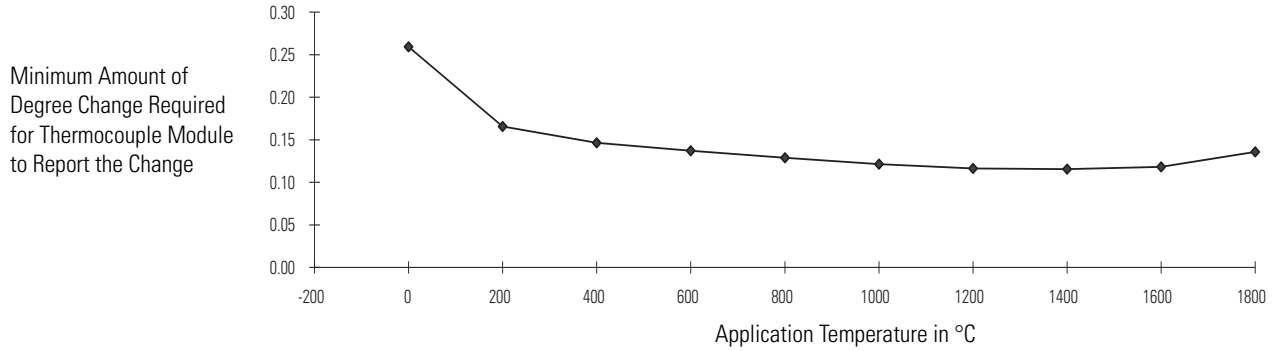
Thermocouple Module Resolution - Type B Thermocouple Connection in a -12…78 mV Input Range



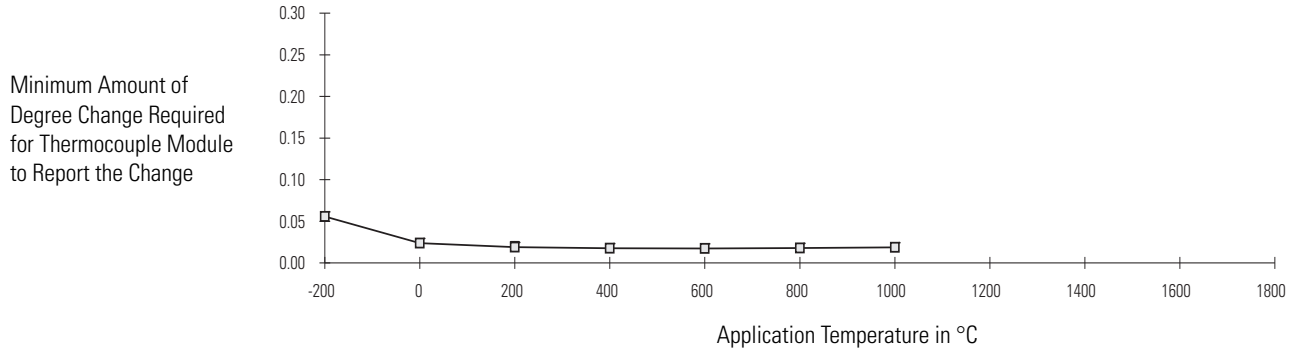
Thermocouple Module Resolution - Type R Thermocouple Connection in a -12…78 mV Input Range



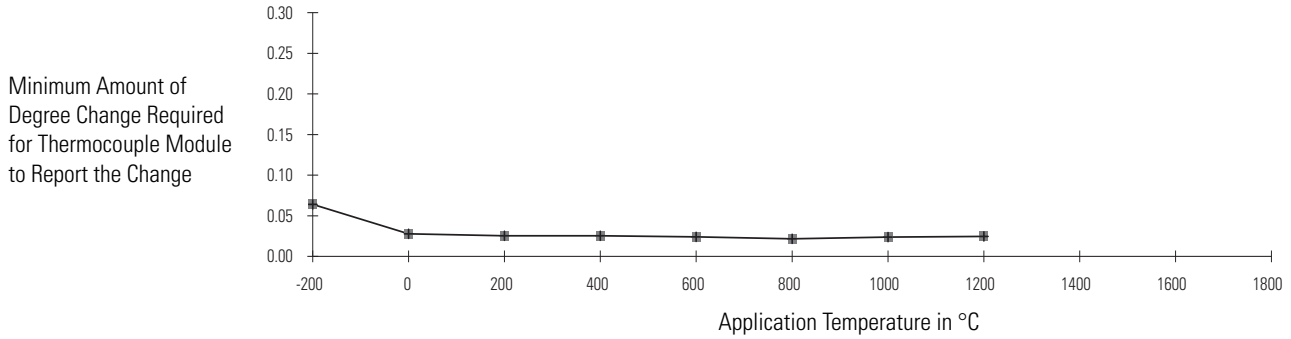
Thermocouple Module Resolution - Type S Thermocouple Connection in a -12…78 mV Input Range



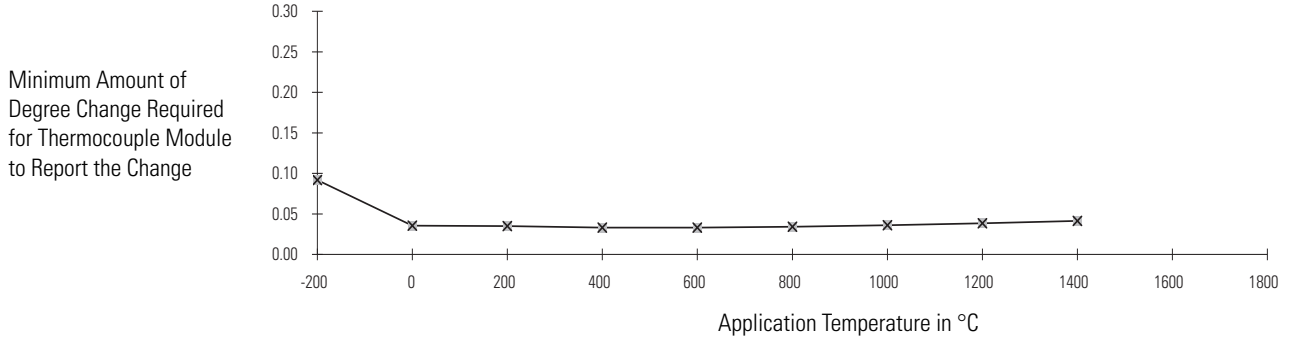
Thermocouple Module Resolution - Type E Thermocouple Connection in a -12…78 mV Input Range



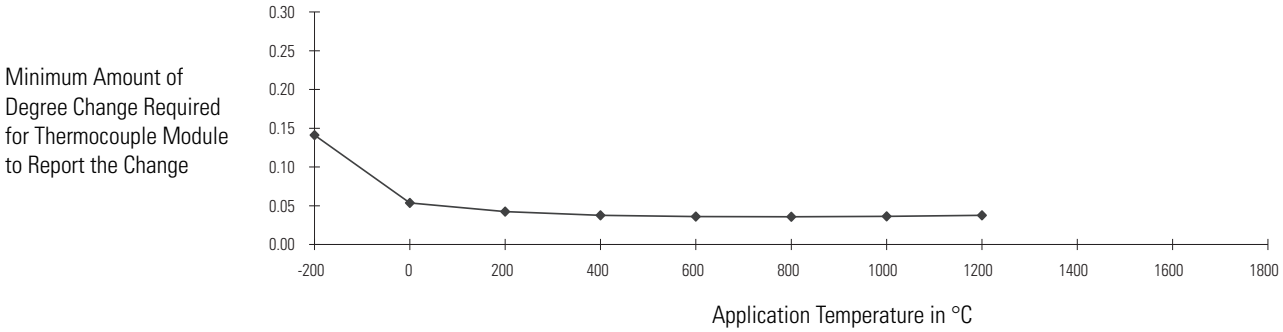
Thermocouple Module Resolution - Type J Thermocouple Connection in a -12…78 mV Input Range



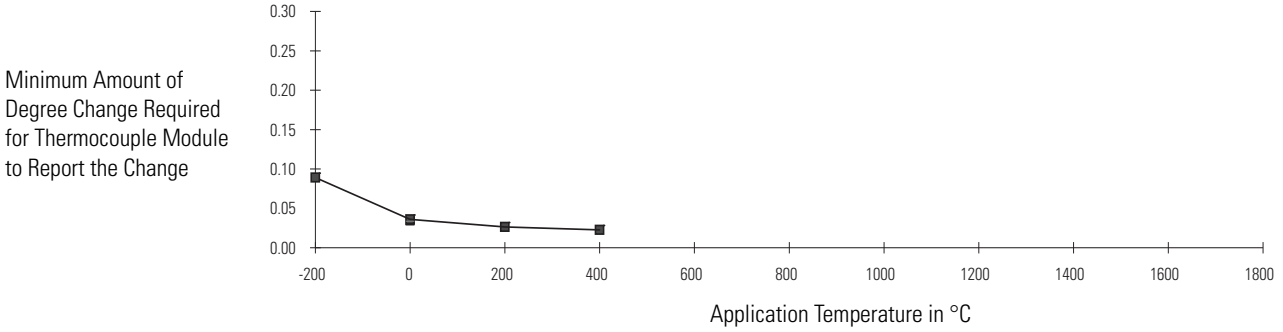
Thermocouple Module Resolution - Type K Thermocouple Connection in a -12…78 mV Input Range



Thermocouple Module Resolution - Type N Thermocouple Connection in a -12…78 mV Input Range



Thermocouple Module Resolution - Type T Thermocouple Connection in a -12…78 mV Input Range



How to Deal with Incorrect Thermocouple Temperature Readings

The first thought when an incorrect temperature reading is reported back in a thermocouple input module is that the module is out of calibration. This is typically not the case, particularly if the module has just been installed out-of-the-box.

All thermocouple input modules are shipped factory calibrated so it is unlikely that they would need to be calibrated on installation.

To determine the cause of the incorrect reading, the nature of the incorrect reading must be discerned first. The module:

1. Always reads maximum.
2. Always reads minimum.
3. Reads erratic (data jumping around).
4. Reads with an offset over the entire range.

In general, if incorrect readings appear on a new install then checking for proper installation and configuration would typically prevail as a cause versus an existing working module where a hardware failure of some type (channel or module) would be more likely the cause.

Also, if more than one channel is experiencing these symptoms, disconnect all thermocouples except one. This can help determine if it is external hardware or the module itself is the cause.

Before attempting to troubleshoot these symptoms, a great deal of work can be saved by first, visually inspecting the module, and second, applying a thermocouple emulator directly to the module input in question. Make sure the module is powered and communicating based on the status indicators. Red or flashing green status indicators signify a problem.

Make sure wiring is intact and correct and the cold junction sensors (CJS) are installed correctly for the correct wiring arm, terminal base, or removable terminal block. If all looks correct, then remove the thermocouple from the channel in question and apply the emulator.

The emulator is designed to provide a voltage at the terminals equivalent to the voltage expected for the thermocouple type it is emulating. If the temperature reports back correctly then the module is performing as expected and the thermocouple and wiring are suspect. If the emulator temperature is not reporting back correctly, then the module hardware, configuration, or the software application are suspect.

We highly recommend using a thermocouple emulator for initial troubleshooting. In lieu of an emulator, a millivolt signal can be applied to the input. To make this work, the module would have to be reconfigured to read a millivolt signal. If the module is reading back the millivolt correctly, then the module is performing as expected.

Troubleshooting Checklist

Check for these symptoms when troubleshooting a module.

1. Thermocouple reading maximum (upscale) usually means that there is an open circuit. Thermocouple modules provide open-circuit detection and the data will report back upscale when an open circuit is detected. Check the wiring, terminations, and for an open thermocouple. Make sure the length of the thermocouple cable is within module specifications, where too long a length, thus a higher impedance, could be interpreted as an open circuit. See page 131 for more information.

2. Thermocouple reading minimum (downscale) usually means that there is a short-circuited input. Check wiring and correct terminations.

3. Erratic readings (data jumping around) are a symptom of noise. The magnitude of noise can be seen with an oscilloscope. Disconnect all but one thermocouple to see if other channels are affecting each other (bleed-over). The effect of noise can be eliminated or reduced by removing or suppressing the source of the noise or by employing the hardware and or software filters provided by the thermocouple module.

4. Offset readings can be caused by a DC signal riding on top of the thermocouple signal. The magnitude of the offset can be seen with an oscilloscope. Again, by disconnecting all but one thermocouple, one can see if other channels are affecting each other (bleed-over).

5. Make sure the module is not in calibration mode. This is module dependant, but in general, specific bits have to be turned on to enable calibration.

The 1756-IT6I Thermocouple module, when configured with all channels for the same configuration and measuring the same (ambient) temperature, will have a temperature reading difference between upper and lower channels up to -13.33…-12.22 °C (8…10 °F). To improve the accuracy of the module's reading, we recommend that you select remote CJ compensation and wire to a 1492-AIFM6TC-3.

Offset readings may also be seen if the CJS is defective or not installed properly. When, provided, check the module input data for a CJS defective diagnostic bit. Thermocouples also report back ambient temperature and will provide an accurate ambient temperature if the CJS is healthy, wired properly, and the module is operating within specifications.

1492 AIFMs for Analog I/O Modules

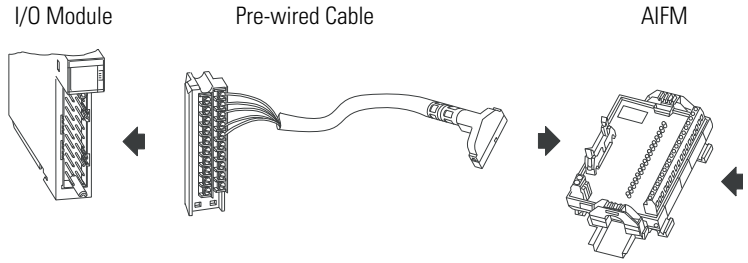
Introduction

As an alternative to buying RTBs and connecting the wires yourself, you can buy a wiring system that connects to I/O modules through pre-wired and pre-tested cables.

IMPORTANT The ControlLogix system has been agency certified using only the ControlLogix RTBs (1756-TBCH, 1756-TBNH, 1756-TBSH and 1756-TBS6H). Any application that requires agency certification of the ControlLogix system using other wiring termination methods may require application specific approval by the certifying agency.

The combinations include the following:

- **Analog interface modules (AIFMs)** mount on DIN rails to provide the output terminal blocks for the I/O module. Use the AIFMs with the pre-wired cables that match the I/O module to the interface module.



  Feed-through and **fusible AIFMs** let you customize the wiring system to your application. The fused AIFMs have 24V DC blown fuse indicators to locate and replace blown fuses.

  For a complete list of the AIFMs available for use with ControlLogix analog I/O modules, see the table on page 384.

- **Pre-wired cables** have a pre-wired RTB on one end to connect to the front of an analog I/O module and a D-shell connector on the other end to plug into a D-shell terminal.

  The D-shell connectors, with either 15 or 25 pins, have a slide-locking mechanism for a secure connection.

  For a complete list of the pre-wired cables available for use with ControlLogix analog I/O modules, see the table on page 387.

The table lists the AIFMs and pre-wired cables that can be used with ControlLogix analog I/O modules.

IMPORTANT For the latest list, see the Digital/Analog Programmable Controller Wiring Systems Technical Data, publication 1492-TD008.

I/O Cat. No.[1]	Mode	AIFM Cat. No. (Fixed Terminal Block)	AIFM Cat. No. (RTB Socket Assembly)	AIFM Type	Description	Pre-wired Cable[5] (x=cable length)
1756-IF6CIS		1492-AIFM6S-3	1492-RAIFM6S-3[2]	Feed-through	6-channel isolated with 3…4 terminals/channel	1492-ACABLExZ
1756-IF6I	Current					1492-ACABLExX
	Voltage					1492-ACABLExY
1756-IF8	Single-ended current	1492-AIFM8-3	1492-RAIFM8-3[3]		8- or 16-channel input or output with 3 terminals/channel	1492-ACABLExTB
		1492-AIFM8-F-5	N/A	Fusible	8-channel input with 24V DC blown fuse indicators, 3 terminals/channel	
	Single-ended voltage	1492-AIFM8-3	1492-RAIFM8-3[3]	Feed-through	8- or 16-channel input or output with 3 terminals/channel	1492-ACABLExTA
		1492-AIFM8-F-5	N/A	Fusible	8-channel input with 24V DC blown fuse indicators, 3 terminals/channel	
	Differential current	1492-AIFM8-3	1492-RAIFM8-3[3]	Feed-through	8- or 16-channel input or output with 3 terminals/channel	1492-ACABLExTD
		1492-AIFM8-F-5	N/A	Fusible	8-channel input with 24V DC blown fuse indicators, 3 terminals/channel	
	Differential voltage	1492-AIFM8-3	1492-RAIFM8-3[3]	Feed-through	8- or 16-channel input or output with 3 terminals/channel	1492-ACABLExTC
		1492-AIFM8-F-5	N/A	Fusible	8-channel input with 24V DC blown fuse indicators, 3 terminals/channel	

I/O Cat. No.[1]	Mode	AIFM Cat. No. (Fixed Terminal Block)	AIFM Cat. No. (RTB Socket Assembly)	AIFM Type	Description	Pre-wired Cable[5] (x=cable length)
1756-IF16	Single-ended current	1492-AIFM8-3	1492-RAIFM8-3[3]	Feed-through	8- or 16-channel input or output with 3 terminals/channel	1492-ACABLExUB
		1492-AIFM16-F-3	N/A	Fusible	16-channel input with 24V DC blown fuse indicators, 3 terminals/channel	
		1492-AIFM16-F-5			16-channel input with 24V DC blown fuse indicators, 5 terminals/channel	
	Single-ended voltage	1492-AIFM8-3	1492-RAIFM8-3[3]	Feed-through	8- or 16-channel input or output with 3 terminals/channel	1492-ACABLExUA
		1492-AIFM16-F-3	N/A	Fusible	16-channel input with 24V DC blown fuse indicators, 3 terminals/channel	
		1492-AIFM16-F-5			16-channel input with 24V DC blown fuse indicators, 5 terminals/channel	
	Differential current	1492-AIFM8-3	1492-RAIFM8-3[3]	Feed-through	8- or 16-channel input or output with 3 terminals/channel	1492-ACABLExUD
		1492-AIFM8-F-5	N/A	Fusible	8-channel input with 24V DC blown fuse indicators, 5 terminals/channel	
		1492-AIFM16-F-3			16-channel input with 24V DC blown fuse indicators, 3 terminals/channel	
		1492-AIFM16-F-5			16-channel input with 24V DC blown fuse indicators, 5 terminals/channel	

I/O Cat. No.[1]	Mode	AIFM Cat. No. (Fixed Terminal Block)	AIFM Cat. No. (RTB Socket Assembly)	AIFM Type	Description	Pre-wired Cable[5] (x=cable length)
IF16	Differential voltage	492-AIFM8-3	1492-RAIFM8-3[3]	Feed-through	8- or 16-channel input or output with 3 terminals/channel	1492-ACABLExUC
		1492-AIFM8-F-5	N/A	Fusible	8-channel input with 24V DC blown fuse indicators, 5 terminals/channel	
		1492-AIFM16-F-3			16-channel input with 24V DC blown fuse indicators, 3 terminals/channel	
		1492-AIFM16-F-5			16-channel input with 24V DC blown fuse indicators, 5 terminals/channel	
1756-IR6I		1492-AIFM6S-3	1492-RAIFM6S-3[2]	Feed-through	6-channel isolated with 3…4 terminals/channel	1492-ACABLExZ
1756-IT6I		1492-AIFM6TC-3	N/A	Thermocouple	6-channel with 3 terminals/channel	1492-ACABLExY
1756-IT6I2						1492-ACABLExYT
1756-OF4	Current	1492-AIFM4-3	1492-RAIFM4-3[4]	Feed-through	4-channel input, output or 2-in/2-out combination with 3 terminals/channel	1492-ACABLExVB
	Voltage					1492-ACABLExVA
1756-OF6CI		1492-AIFM6S-3	1492-RAIFM6S-3[2]		6-channel isolated with 3…4 terminals/channel	1492-ACABLExY
1756-OF6VI						
1756-OF8	Current	1492-AIFM8-3	1492-RAIFM8-3[3]		8- or 16-channel input or output with 3 terminals/channel	1492-ACABLExWB
	Voltage					1492-ACABLExWA

(1) Some analog I/O modules can be operated in up to four modes (current/voltage, single-ended/differential) based on connections. In all cases, each channel is factory-configured for the same mode. However, you can field configure any channel for another mode. You nay need to alter the terminal block wiring to match the application. Refer to the controller installation manual.

(2) Compatible RTB plug; 1492-RTB12N (screw-style terminals) or 1492-RTB12P (push-in style terminals). Order plugs separately.

(3) Compatible RTB plug; 1492-RTB16N (screw-style terminals) or 1492-RTB16P (push-in style terminals). Order plugs separately

(4) Compatible RTB plug; 1492-RTB8N (screw-style terminals) or 1492-RTB8P (push0in style terminals). Order plugs separately.

(5) Cables are available in lengths of 0.5 m, 1.0 m, 2.5 m, and 5.0 m. To order, insert the code for the desired cable length into the catalog number in place of the x: 005=0.5 m, 010=1.0 m, 025=2.5 m, 050=5 m. Example: 1492-ACABLE025TB is for a 2.5 m cable, and the letters TB.

The table describes the I/O module-ready pre-wired cables available for use with your ControlLogix analog I/O modules.

Cat. No.[1]	No. of Conductors[2] [3]	Conductor Size	Nominal Outer Diameter	RTB at the I/O Module End
1492-ACABLExM	11 twisted pairs	22 AWG	11.5 mm (0.45 in.)	1756-TBCH
1492-ACABLExX	9 twisted pairs	22 AWG	6.8 mm (0.27 in.)	1756-TBNH
1492-ACABLExY	9 twisted pairs	22 AWG	6.8 mm (0.27 in.)	1756-TBNH
1492-ACABLExYT	9 twisted pairs	22 AWG	6.8 mm (0.27 in.)	1756-TBNH
1492-ACABLExZ	20 conductors	22 AWG	8.4 mm (0.33 in.)	1756-TBNH
1492-ACABLExTA	20 conductors	22 AWG	8.4 mm (0.33 in.)	1756-TBCH
1492-ACABLExTB	20 conductors	22 AWG	8.4 mm (0.33 in.)	1756-TBCH
1492-ACABLExTC	5 twisted pairs	22 AWG	8.4 mm (0.33 in.)	1756-TBCH
1492-ACABLExTD	5 twisted pairs	22 AWG	8.4 mm (0.33 in.)	1756-TBCH
1492-ACABLExUA	20 conductors	22 AWG	8.4 mm (0.33 in.)	1756-TBCH
1492-ACABLExUB	20 conductors	22 AWG	8.4 mm (0.33 in.)	1756-TBCH
1492-ACABLExUC	9 twisted pairs	22 AWG	6.8 mm (0.27 in.)	1756-TBCH
1492-ACABLExUD	9 twisted pairs	22 AWG	6.8 mm (0.27 in.)	1756-TBCH
1492-ACABLExVA	20 conductors	22 AWG	8.4 mm (0.33 in.)	1756-TBNH
1492-ACABLExVB	20 conductors	22 AWG	8.4 mm (0.33 in.)	1756-TBNH
1492-ACABLExWA	9 twisted pairs	22 AWG	6.8 mm (0.27 in.)	1756-TBNH
1492-ACABLExWB	9 twisted pairs	22 AWG	6.8 mm (0.27 in.)	1756-TBNH

(1) Cables are available in lengths of 0.5m, 1.0m, 2.5m, and 5.0m. To order, insert the code for the desired cable length into the catalog number in place of the x: 005=0.5m, 010=1.0m, 25=2.5m, 050=5m. Build-to-order cable lengths are also available.

(2) Each cable for analog I/O has an overall shield with a ring lug on a 200mm (8.87 in.) exposed drain wire at the I/O module end of the cable.

(3) Not every connection is always used.

Notes:

analog interface module (AIFM)

Modules connect to pre-wired cables to provide the output terminal blocks for the analog I/O module. These modules can be mounted on a DIN rail.

broadcast

Data transmissions to all addresses or functions.

communication format

Format that defines the type of information transferred between an I/O module and its owner-controller. This format also defines the tags created for each I/O module.

compatible match

An electronic keying protection mode that requires that the physical module and the module configured in the software to match according to vendor and catalog number. In this case, the minor revision of the module must be greater than or equal to that of the configured slot.

connection

The communication mechanism from the controller to another module in the control system.

coordinated system time (CST)

Timer value which is kept synchronized for all modules within a single ControlBus chassis.

direct connection

An I/O connection where the controller establishes an individual connection with I/O modules.

disable keying

An electronic keying protection mode that requires no attributes of the physical module and the module configured in the software to match.

download

The process of transferring the contents of a project on the workstation into the controller.

electronic keying

A feature where modules can be requested to perform an electronic check to make sure that the physical module is consistent with what was configured by the software.

exact match

An electronic keying protection mode that requires the physical module and the module configured in the software to match according to vendor, catalog number, major revision and minor revision.

field side

Interface between user field wiring and I/O module.

inhibit

A ControlLogix process that lets you configure an I/O module but prevent it from communicating with the owner-controller. In this case, the controller behaves as if the I/O module does not exist at all.

interface module (IFM)

A module that uses pre-wired cable to connect wiring to an I/O module.

listen-only connection

An I/O connection where another controller owns/provides the configuration and data for the module.

major revision

A module revision that is updated any time there is a functional change to the module.

minor revision

A module revision that is updated any time there is a change to the module that does not affect its function or interface.

multicast

Data transmissions that reach a specific group of one or more destinations.

multiple owners

A configuration set-up where multiple owner-controllers use exactly the same configuration information to simultaneously own an input module.

network update time (NUT)

The smallest repetitive time interval in which the data can be sent on a ControlNet network. The NUT ranges from 2 ms to 100 ms.

owner-controller

The controller that creates and stores the primary configuration and communication connection to a module.

program mode

In this mode the following events occur:

- Controller program is not executing.
- Inputs are still actively producing data.
- Outputs are not actively controlled and go to their configured Program mode.

rack connection

An I/O connection where the 1756-CNB module collects digital I/O words into a rack image to conserve ControlNet connections and bandwidth.

rack optimization

A communication format in which the 1756-CNB module collects all digital I/O words in the remote chassis and sends them to controller as a single rack image.

remote connection

An I/O connection where the controller establishes an individual connection with I/O modules in a remote chassis.

removal and insertion under power (RIUP)

ControlLogix feature that allows a user to install or remove a module or RTB while power is applied.

removable terminal block (RTB)

Field wiring connector for I/O modules.

requested packet interval (RPI)

The maximum amount of time between broadcasts of I/O data.

run mode

In this mode, the following events occur:

- Controller program is executing
- Inputs are actively producing data
- Outputs are actively controlled

service

A system feature that is performed on user demand, such as fuse reset or diagnostic latch reset.

system side

Backplane side of the interface to the I/O module.

tag

A named area of the controller's memory where data is stored.

timestamping

A ControlLogix process that stamps a change in input data with a relative time reference of when that change occurred.

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User Manual